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A Multi-Context Intervention to Promote Physical Activity in  
Preschool Children and Identify Barriers to PA in the Home

Casey Henehan

College Honors Thesis, University of Vermont

HON 249

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### Abstract

Physical activity (PA) is important for preschoolers' health. This study piloted the addition of in-home online exercise videos, *Kiddie CATs at Home*, to a previously existing in-school PA intervention, *Kiddie CATs on the Move* (Meyer et al., under review; Meyer et al., 2019) creating a multi-context PA program for preschool children. Additionally, this project explored health-related behaviors (screen time, sleep) and barriers and facilitators to children's PA outside of school. Families were recruited as part of a larger program evaluation study of the *Kiddie CATs on the Move* PA intervention. Forty-two parents of participating preschool children ( $M_{age} = 3.98$ ,  $SD = 0.59$ , 52.4% male, 40.5% Caucasian, 31% Asian, 19% African American, 2.4% Latinx, and 7.1% other) completed a 14-item parent survey created specifically for use on this project. Correlational analyses indicated a significant positive association between Head Start enrollment status and school day screen use. Weekend and school day screen use were also significantly positively correlated. A paired-samples *t*-test comparing mean weekday and weekend screen time revealed that, on average, screen use was higher on weekend days than on school days. A significant positive correlation was found between average hours slept on weekends and average hours slept on weekdays. Parents reported children had positive responses to the intervention. Themes in parents' responses from qualitative coding of the questionnaires related to children's experiences watching the *Kiddie CATs at Home* videos, children's current PA behavior outside of school, and characteristics of barriers/facilitators to PA. This study highlights the potential for video-based PA interventions to engage preschool children in PA in the home.

## **A Multi-Context Intervention to Promote Physical Activity in Preschool Children and Identify Barriers to PA in the Home**

A growing body of research supports the importance of physical activity (PA) for preschool children. For example, greater levels of PA have been found to benefit preschool children's motor skills, body composition, metabolic health, and social development (Tremblay et al., 2012), suggesting PA may be beneficial for preschoolers' development. To promote preschool PA, the U.S. Institute of Medicine's (IOM) Early Childhood Obesity Prevention Policies recommend that preschoolers are provided with opportunities for light, moderate, and vigorous PA for a minimum of 15 minutes per waking hour in childcare (IOM, 2011). An investigation by Pate and colleagues (2015) found that at least half the preschoolers in two large independent samples were not adhering to the IOM PA guideline. In addition, a 2019 study found preschoolers were only meeting IOM guidelines on 62.41% of assessment days (Tompkins et al., 2019). Based on these findings, more opportunities to engage in PA must be provided for preschoolers, who may not be meeting IOM PA guidelines at preschool alone.

O'Neill and colleagues (2016) found that children who did not meet IOM PA guidelines in school engaged in similar levels of out-of-school PA as those who did meet the guidelines during the school day. Specifically, children who do not meet IOM PA guidelines in school do not seem to compensate by participating in greater levels of PA outside of school in comparison to their peers who do meet guidelines (O'Neil et al., 2016). Considering these findings, interventions could increase PA opportunities for children in school or outside of school, but more opportunities must be provided for children to engage in PA throughout the day, as they are not meeting PA guidelines in preschool settings alone. As such, novel interventions promoting PA opportunities outside preschool may help to address this issue.

Spence and Lee (2003) propose the use of Bronfenbrenner's bioecological model (1977) as a framework for promoting PA. Bronfenbrenner's model proposes that children interact with their environment at different contextual levels, with each level influencing their development. According to the model, children directly participate in their environments at the "microsystem" level, which includes school and home environments, separately. The "mesosystem," a higher level of the model, connects individual microsystems (Bronfenbrenner, 1977). Spence and Lee (2003) suggest the "mesosystem" level is key for shaping PA behavior because supporting connections between PA behavior in various microsystems (e.g., home and school) ultimately enhances the quality of interventions. Within their proposed model, they include "parental support for PA at home" and "child's involvement in PA at school" as mesosystem levels of influence (Spence & Lee, 2003, p. 15). In alignment with their model, an intervention that promotes communication and connection between mesosystems would be consistent with Bronfenbrenner's theoretical framework to bolster children's PA.

Following the framework outlined by Spence and Lee (2003), the primary goal of the current project is to pilot the addition of in-home online exercise videos (i.e., *Kiddie CATs at Home*) to a previously existing in-school PA intervention (i.e., *Kiddie CATs on the Move*; Meyer et al., under review; Meyer et al., 2019) to create a multi-context PA program for preschool children. *Kiddie CATs on the Move* is a 30-minute structured PA program comprised of a five-minute "Plan" period in which expectations and rules are outlined, four five-minute "Do" periods of activity with a one-minute review between each, and a two-minute final review to stretch and discuss the benefits of PA (Meyer et al., 2019). *Kiddie CATs at Home* allows children to engage in the *Kiddie CATs on the Move* activities at home by streaming videos of the activities.

Videos may be an effective PA intervention medium because they can be used at both home and school and can be easily supervised by adults. In a previous examination, teachers reported a lack of preschool age-appropriate exercise videos (Obeng, 2009). To date, only one study has examined the effects of a video intervention on child PA behaviors. In their investigation, Levin and colleagues (2002) found that showing videos to kindergarten through second-grade students about the importance of PA increased their knowledge of basic cardiovascular function and of the benefits of PA. A greater percentage of children in the intervention group found PA to be enjoyable compared to the control group at posttest (Levin et al., 2002). These findings suggest video interventions may be effective in promoting children's PA, warranting further investigation.

Further, PA interventions utilizing mass media have been found to have potential to reach larger numbers of individuals, which may be important as face-to-face interventions may not be accessible to larger populations (Lau et al., 2011). Despite this, mass media approaches are less personalized than face-to-face interventions, therefore tailoring interventions to the target population should be considered (Lau et al., 2011). Information and communication technologies (e.g., internet, mobile phones) have shown positive effects in PA interventions for children and adolescents particularly when combined with face-to-face delivery approaches (Lau et al. 2011).

An examination of a structured exergaming intervention (Dance, Dance, Revolution) with school-aged Latinx children provides additional support for the potential for video-based PA interventions to promote PA in young children. Specifically, participants in this study showed improved cardiovascular fitness over time, as compared to a control group that did not participate in structured exercise (Gao et al., 2013). Relatedly, a study of urban school-aged children found a significant increase in PA participation following the use of a structured

exergaming-based program over time when compared to a control group (Gao & Xiang, 2014). Additionally, the participants expressed positive attitudes surrounding the exergaming exercise intervention and their own fitness ability (Gao & Xiang, 2014). In this way, exergaming has been shown to foster improvements in fitness and PA participation, along with positive attitudes regarding PA.

Similarly, parent support may be another facilitator to improving children's PA behaviors as parents view themselves as critical contributors to a healthy home environment for their children (Lindsay, Wallington, et al. 2018). Specifically, parental support of PA was related to child PA (Trost et al., 2003). Supportive parental behaviors (e.g., positively reinforcing PA behaviors, limiting sedentary behaviors) have been shown to increase children's PA (Lindsay, Wasserman, et al., 2018). Although parental support may be a facilitator for PA, most American adults do not meet the recommended guidelines for PA themselves (Beauchamp et al., 2017), suggesting some parents may not be ideal PA role models. This finding highlights the need for interventions that promote PA behaviors for children at home that parents can readily support and that may require minimal parental PA engagement.

Parent support for PA may also be limited because parents have reported financial costs associated with organized PA activities as a barrier to PA, particularly in single-income families (Irwin et al., 2005). Additionally, parents reported insufficient time was found to be a barrier to preschoolers' PA at home, especially in families with working parents (Irwin et al., 2005). Moreover, parental perceptions and attitudes about their child's environment can also serve as barriers or facilitators to PA. For example, parental perception of a community's physical environment may influence the amount of time preschoolers spend outside (Cerin et al., 2016). Location barriers are also relevant to rural families, with a 2017 study finding that rural

environments may be a barrier to PA due to distance from recreation places (Hesketh et al., 2017; Buro et al., 2015).

Finally, weather is another important factor to consider related to children's PA. When outside, preschoolers are more likely to engage in moderate to vigorous PA (MVPA, Cerin et al., 2016). Both parents (Lindsay, Wasserman et al., 2018) and children (Eyre et al., 2015) have reported that parents keep their children inside in inclement conditions (e.g., windy, wet, cold), limiting children's PA opportunities. When interviewing parents of preschoolers, Irwin et al. (2005) found warmer seasons were more favorable for children's PA than the colder seasons. Additional efforts need to be made as "innovative solutions are necessary to promote involvement in physical activities during winter" (Tucker & Gilliland, 2007, p. 920).

Taken together, these findings suggest that there are numerous barriers that can restrict children's PA, which may mean children have more time to engage in sedentary behaviors like screen time. A 2017 study found children ages birth to eight spend 139 minutes, on average, interacting with various forms of screen media (e.g., TV, DVDs, computers, video games, mobile devices) per day (Rideout, 2017). The absence of "safe, affordable, and entertaining facilities" outside the home, a lack of outdoor space, and unsafe outdoor environments have been noted as barriers to lessening screen time (Minges et al., 2015, p. 392). Facilitators to reducing screen time include access to a large outdoor space that promotes recreation (Minges et al., 2015). Importantly, Pate et al. (1997) found a strong association between reported television watching time and PA participation. Children who watched television or played video games for three or more hours after school were more likely to have low rates of activity than those who engaged in less screen time (Pate et al., 1997). In addition, parents who believed they were able to influence their child's PA had children who were less likely to exceed guidelines for screen



time. In contrast, when parents reported struggling to influence their child's PA, their children were more likely to exceed screen time recommendations (Smith et al., 2010). Additionally, greater TV viewing has been linked to shorter sleep duration in children, another important health behavior with serious implications for child development (Cespedes et al., 2014).

Sleep is critical to early-life brain development, and disruption has been linked with an assortment of adverse outcomes in preschoolers such as decreased prosocial behavior, greater levels of hyperactivity and inattention, reduced cognitive ability, and decreased emotional maturity (Tso et al., 2016). Parents reported that young children with shorter sleep duration had significantly higher psychiatric symptom scores compared to peers who slept longer (Paavonen et al., 2009). Tso and colleagues (2016) found only 11% of a preschool-aged sample slept for the National Institutes of Health recommended 11-12 hours per night. Children who met sleep recommendations scored higher than those who did not on tests of school readiness (Tso et al., 2016). Greater total sleep time in preschoolers has been associated with an increased percentage of time spent in PA (Hinkley et al., 2012). Conversely, low levels of child PA have been associated with less sleep (Sääkslahti et al., 2004), furthering the need for interventions increasing child PA.

### **The Current Study**

The primary goal of the current study was to examine factors related to the use of *Kiddie CATs at Home*, the online complement to the *Kiddie CATs on the Move* school-based PA program. This pilot project is exploratory and assesses if children are actively engaged by and enjoy the *Kiddie CATs at Home* videos. *Kiddie CATs at Home* is an important intervention that was developed to address barriers to children's participation in PA as reviewed above. First, *Kiddie CATs at Home* is delivered at no-cost to families. Additionally, *Kiddie CATs at Home* is

accessible regardless of location and requires no transportation to access the videos as long as the family has access to the internet and an electronic device. Furthermore, *Kiddie CATs at Home* is a solution to the barrier of inclement weather conditions, as it is a video-based intervention that can be done in the home. The *Kiddie CATs at Home* intervention is also unique as it builds on an in-school, in-person intervention with an at-home video intervention and is accessible on any internet platform. Importantly, this is a pilot study, and any data collected will be used to refine the *Kiddie CATs at Home* program for continued use. To best inform the continued development of this intervention, a qualitative examination of the barriers and facilitators to PA in this population was included as part of this study. In addition, assessment of child screen time and sleep was also needed to best understand the levels of these behaviors in this sample and if they are related to participation in *Kiddie CATs at Home*.

## Method

### Participants

Families were recruited as part of a larger program evaluation study of the *Kiddie CATs on the Move* PA intervention (Meyer et al., under review; Meyer et al., 2019). Parents provided written consent prior to any data collection, and the University of Vermont Institutional Review Board approved this study (CHRBSS 17-0022). All families participating in the *Kiddie CATs on the Move* study were invited to access the *Kiddie CATs at Home* videos and complete the questionnaire utilized for the purposes of the current study. Parents of a subset of children ( $n = 42$ ) participating in the larger study completed the questionnaire. The forty-two participating preschoolers ranged in age from 2.99 – 4.93 years ( $M = 3.98$ ,  $SD = 0.59$ ) and were 52.4% male. The sample was racially and ethnically diverse (40.5% Caucasian, 31% Asian, 19% African American, 2.4% Latinx, and 7.1% other). A majority of the children in the sample (76.2%) were

enrolled in Head Start programs. Preschoolers were recruited from Head Start affiliated classrooms in rural and small urban locations.

### **Measure**

Data were collected via a 14-item parent survey created specifically for use on this project. The questionnaire assessed child use and enjoyment of the *Kiddie CATs at Home* videos, child activity/engagement with the videos, home health behaviors (sleep, screen time and characteristics of PA), and barriers/facilitators to PA outside of school. The questionnaire is comprised of both questions with Likert scale responses and open-ended responses. Parents responded to a four-point Likert scale asking how many times children watched the *Kiddie CATs at Home* videos (0 = 1 - 3, 1 = 4 - 6, 2 = 7 - 9, 3 = 10 or more). Additionally, parents responded using four-point Likert scales to items asking how much children enjoyed the videos (0 = not at all, 1 = just a little, 2 = pretty much, 3 = very much), and how active children were while watching the videos (0 = not at all, 1 = just a little, 2 = pretty much, 3 = very much). Screen use not related to PA on both weekends and school days was assessed using a five-point Likert scale (0 = 0 hours, 1 = less than 1 hour, 2 = 1 - 2 hours, 3 = 3 - 4 hours, 4 = 5 or more hours). Parents provided open-ended responses to items that assessed their children's enjoyment of the videos, favorite physical activities outside of school, sleep and wake times on school days and on weekends, and barriers and facilitators to PA outside of school.

### **Procedure**

Prior to data collection, an informational flyer was sent home to each family and information about the study was emailed or texted to families by children's classroom teachers to inform families about the *Kiddie CATs at Home* videos. Additionally, classroom teachers were provided with an information sheet so they would be able to answer questions families may have

regarding *Kiddie CATs at Home*. Finally, research staff visited schools during child pick-up or drop-off to answer any questions from parents about *Kiddie CATs at Home*.

Families were invited to access the videos through the *CATs on the Move* website (“Children and Teachers (CATS) On the Move,” n.d.). The *Kiddie CATs at Home* video library includes a variety of 30-minute full programs or five-minute PA activity videos. The videos incorporate various game-based and dancing activities. The videos were created by experienced *Kiddie CATs on the Move* program facilitators using the structure, activities, and graphics from the established school-based intervention, *Kiddie CATs on the Move*. The videos were created specifically for use in this project.

Correlational analyses were used to investigate relations among children’s use and enjoyment of the PA videos, children’s activity while watching the videos, home health behaviors (sleep and screen time), and key demographic variables (e.g., sex, age, Head Start status). Paired-sample *t*-tests were used to determine if there was a significant difference between the means of screen time use on school days and weekend days, and to determine if there was a difference between children’s average hours of sleep on weekends and school days. All correlational and *t*-test analyses were conducted using IBM SPSS version 26.0 software.

Responses to open-ended questions regarding characteristics of child PA and barriers/facilitators to PA outside of school were assessed and coded via qualitative methods using NVivo 12 software. Codes were created to capture themes in parents’ responses related to children’s experiences watching the *Kiddie CATs at Home* videos, children’s current PA behavior outside of school, and characteristics of barriers and facilitators to PA. The open-ended response questions from the questionnaire were compiled into transcripts, which were then coded

by two members of the research team and compared for inter-rater reliability. The codes were then analyzed for common themes.

## Results

Descriptive statistics and correlations between all study variables are presented in Table 1. Out of the 42 families who responded to the questionnaire, 40.5% of families indicated their children watched the *Kiddie CATs at Home* videos, and 59.5% indicated their children did not watch. A small but significant positive association was found between Head Start enrollment status and school day screen use for things that were not PA, suggesting that, on average, Head Start enrolled children used screens more on school days than children not enrolled in Head Start.

Weekend and school day screen use for purposes other than PA were also significantly positively correlated, suggesting higher levels of school day screen time were linked with higher levels of weekend screen time. Results of a paired-samples *t*-test comparing mean weekday and weekend screen time revealed that, on average, screen use was higher on weekend days ( $M = 2.24, SD = .77$ ) than on school days ( $M = 1.90, SD = .83$ ). This difference was significant,  $t(40) = -2.65, p = .01$ , and represented a small-to-moderate effect size,  $d = .41$ .

In addition, a significant positive correlation was found between average hours slept on weekends and average hours slept on weekdays, suggesting higher levels of school day sleep were linked with higher levels of weekend sleep. On school days, parents reported the preschoolers in this sample slept between 8.5 and 12.5 hours ( $M = 10.77, SD = 0.92$ ). On weekend nights, parents reported the preschoolers in this sample slept between 9.5 and 13 hours ( $M = 10.97, SD = 0.87$ ). Findings from a paired-samples *t*-test revealed that no significant

difference was found between the time preschoolers slept on weekday nights compared to weekend nights.

Out of the 17 children who watched the videos, 16 watched 1 - 3 times and 1 child watched 4 - 6 times. On average, parents rated children's enjoyment of the *Kiddie CATs at Home* videos at 2.0 ( $SD = 0.79$ ) corresponding to the "pretty much" response item on the enjoyment questions. All parents reported that their children experienced at least some level of enjoyment while watching the videos. Additionally, parents reported that children's average activity levels while watching the *Kiddie CATs at Home* videos was 2.12 ( $SD = 0.78$ ) which corresponds to in between the "pretty much" and "very much" response items on the questionnaire.

Families also answered open-ended questions about their preschool children's PA behavior at home, enjoyment of the *Kiddie CATs at Home* videos, and barriers and facilitators to PA. Of the 17 parents who reported their children watched the *Kiddie CATs at Home* videos, 16 responded to the first question regarding their children's experiences watching the videos. These responses fell into four common themes. The first theme identified was that almost one-third of these parents noted that their children made a connection between the *Kiddie CATs at Home* videos they were watching and the *Kiddie CATs on the Move* program they participate in at school. For example, one parent noted that their child, "... thought it was 'very cool' and explained 'I do this at school! Those are *Kiddie CATs* teachers' ...!" Another theme that emerged was that over one-third of these parents noted their children were active and engaged in PA while watching the videos. For example, one parent wrote their child was, "imitating what he was seeing and hearing." Additionally, half of the parents noted that their children enjoyed the videos. Also, though not as common as the other types of responses, four parents described being engaged by their children, either through PA or an explanation of the games played while

watching the *Kiddie CATs at Home* videos. Importantly, three parents whose children did not watch the *Kiddie CATs at Home* videos reported issues accessing the videos. For example, one parent noted, “we need the link so we can watch it.”

When considering responses from all parents who responded to the survey regardless of whether their children watched the *Kiddie CATs at Home* videos, parents described many different types of favorite physical activities their children enjoy doing outside of school. Most parents reported at least one outdoor activity among their children’s favorites, making outdoor physical activities among the most commonly listed. Frequently reported examples of outdoor activities included biking, playing in the snow, general “playing outside,” and playing at the playground. Conversely, only four parents reported specific indoor activities as their child’s favorite type of PA. Examples of these included going to a local indoor play area and one parent wrote that, “in the colder months he does a lot of running around our living room and we set up obstacle courses pretty regularly.”

Importantly, when asked about their child’s favorite physical activity outside of school, many parents listed multiple favorite activities. Almost one-half of parents also reported that their children’s favorite physical activities required equipment, including bike riding, playing different sports (i.e. football, soccer), sledding, and jumping on trampolines. On the other hand, almost three-fourths of parents noted that their children’s favorite physical activities could be performed without equipment. Common equipment-independent activities that children enjoyed were running, games such as chase and playing at the park. Less commonly, three parents reported that their children’s favorite physical activities included family playmates. In addition, almost one-fifth of parents reported their children’s favorite physical activities included

participating in structured PA classes or sports. Examples included “Ballet class at the YMCA,” and playing soccer or football.

Over one-fourth of the sample reported that there were no barriers to their children’s exercise outside of school. Ten parents in the sample reported specific barriers to their children’s PA. When parents did note barriers to their children’s PA, they most commonly reported barriers related to weather and the seasons. Examples of weather and seasonal barriers included snow, the cold, and limited daylight, suggesting that winter may be a difficult season for engaging in PA in this sample. In addition to seasonal barriers, one parent noted finances as a barrier to their child’s exercise outside of school, and two parents noted health-related barriers, including both physical and mental health conditions of the parent, as deterrents to their child’s exercise outside of school.

Finally, parents reported on facilitators of their children’s PA outside of school. Similar to parents’ reports of their children’s favorite types of activities, over half of the parents listed opportunities to engage in outdoor activities as facilitators to their children’s PA. Further, about one-fourth of the sample reported having access to PA equipment motivated their children to exercise. Examples of equipment included bikes, sleds, and balls for sports (e.g., footballs, basketballs). Additionally, about one-fifth of the sample reported their children were motivated by having access to places to be physically active in the community. For example, two parents noted the park and one parent mentioned the playground motivated their children to be physically active. Additionally, exploring new places and going on adventures were noted as motivating by two parents. Having peers to engage with also was reported to facilitate PA for one-fourth of the sample. About one-eighth of the sample reported having family playmates was a facilitator to their children’s exercise outside of school. Cousins, siblings, and parents were



listed as examples of family playmates. Examples of family activities included, “playground play with cousins” and “family runs, hikes, [and] dance parties.” Less commonly, three parents reported that external motivators (e.g., rewards, the dogs) incentivized their children to exercise. Six parents reported that their children were self-motivated to exercise. Parent responses about what motivated their child to exercise outside of school that indicated intrinsic motivation included, “she has a lot of energy and loves to be moving” and, “Pretty much anything. He loves to be active.” Finally, structured PA (i.e., sports and classes) was reported to facilitate PA outside of school for four children in this sample.

### **Discussion**

The goal of this study was to pilot the addition of the in-home exercise video component, *Kiddie CATs at Home* to a previously existing in-school PA intervention, *Kiddie CATs on the Move*. Additionally, this study explored barriers and facilitators to PA in this population along with health-related behaviors outside of school, such as children’s sleep and screen time, and how they are associated with participation in the home-based intervention.

Interestingly, a positive association was found between Head Start enrollment status and school day screen use for things that were not PA, which suggests that on average, children enrolled in Head Start use screens more on school days than children who were not enrolled in Head Start. Children from lower-income families have been found to use screens for an average of an hour and 39 minutes more per day than children from higher-income families (Rideout et al., 2017). Previous work has noted the absence of safe, accessible, and affordable places for recreation to be a barrier to lessening screen time (Minges et al., 2015). This may be particularly relevant for families with Head Start status, as financial barriers may prevent access to places for children to play. Additionally, finances may be a barrier to opportunities for structured PA, or

access to PA equipment, and both access to equipment and opportunities for structured PA were noted as themes of children's favorite physical activities in this sample. Screens may therefore be a more accessible entertainment option for children in low SES populations, but future work should explore this further.

Additionally, a positive correlation was found between school day and weekend screen use for purposes other than PA, highlighting that higher levels of school day screen use were linked with higher levels of weekend screen use. On average, parents reported higher screen use on weekends than on school days. A 2017 study found that children from birth to eight years old spend an average of 139 minutes per day interacting with screen media (Rideout, 2017). The majority of children in our sample used screens for 1-2 hours on school and weekend days, suggesting that the children in this sample may be using screens less than those who participated in the Rideout (2017) study. There are several possibilities that may explain this finding. The children in our sample may be using screens less than the average reported by Rideout (2017) because of the in-school PA intervention, *Kiddie CATs on the Move*, in which children learn about the importance of PA. Thus, children may be more likely to spend time at home engaging in PA because they have learned about its importance at school. However, future research is needed to examine this hypothesis. Importantly, findings from previous research suggest children who engaged with screens for three or more hours after school were more likely to be less active than children who spent less time using screen media (Pate et al., 1997), highlighting the possibility that children in our sample may be more active than children with higher levels of daily screen time.

Average hours slept on school days and average hours slept on weekend days were also found to be positively correlated. This finding suggests that, on average, higher levels of school

day sleep were linked with higher levels of weekend sleep. On average, the children in our sample slept 10.77 hours on school days and 10.97 hours on weekend days, which is approximately in compliance with the National Institute of Health's recommended 11-12 hours of sleep per night. However, despite the average hours of sleep approximating compliance with guidelines, a number of children in this sample fell below the recommended guidelines for hours of sleep per night. Previous research indicates that greater sleep time in preschoolers is associated with an increase in time spent in PA (Hinkley et al., 2012), and less sleep time has been associated with lower levels of PA in children (Sääkslahti et al., 2004). These findings suggest the possibility that PA interventions could promote compliance with national sleep guidelines for preschoolers. Additionally, children who are not meeting the sleep guidelines may not have the energy to engage in enough PA to meet PA guidelines. Thus, PA participation may promote sleep, and more sleep may also facilitate participation in PA. Future research is necessary to fully understand the interplay between PA and sleep in preschoolers.

Parents of children who watched the videos all reported that their children experienced at least some level of enjoyment while watching the videos. Average enjoyment corresponded to the "pretty much" response item on the enjoyment questions and children's average activity levels corresponded to in-between the "pretty much" and "very much" response items from the questionnaire. Enjoyment of PA makes it more likely that children will continue to engage in PA behaviors, as noted by Cairney and colleagues (2012). In light of these findings, the children in our sample's enjoyment of *Kiddie CATs at Home* suggests that they may continue to engage in PA, either through the videos or other forms of PA.

Although the children who did watch the videos enjoyed them, parent reports indicated fewer than half of the sample watched the videos. This result suggests further work is necessary

to identify the best approaches for disseminating information about *Kiddie CATs at Home* to families. Our outreach strategy may have contributed to the low numbers of families that watched the videos. For example, one parent reported needing the link to watch the videos. Therefore, despite our dissemination efforts (e.g., distributing paper fliers with the link to the videos to all families and asking classroom teachers to text the link to families), we still did not successfully reach all families. Additionally, there is a possibility that an online video-based exercise intervention may not be interesting to all of the families in our sample. Further work to examine interest and accessibility is necessary to better develop the intervention.

Qualitative findings indicated preschoolers connected *Kiddie CATs at Home* to *Kiddie CATs on the Move*, were active while watching the videos, enjoyed the videos, and tried to engage their parents while watching. These results suggest that they were actively engaged while viewing and enjoyed the videos which lends support to the effectiveness of this intervention to promote children's PA. Although a small number of families watched the videos, it is clear that *Kiddie CATs at Home* was successful in promoting children's PA and they enjoyed watching the videos. These findings highlight that there is promise for video-based interventions for preschoolers. The connection between school and home interventions is particularly interesting, as it shows linking what children are learning in school to their home environment may be a potential avenue for preschool PA interventions. This finding is in alignment with the model presented by Spence and Lee (2003), which suggests interventions that promote connection and communication between children's environments (e.g., home and school) are most likely to be successful.

Around one-fifth of the sample reported barriers to their children's PA. Reported barriers to PA included seasonal-related barriers, financial-related barriers, and health-related barriers.

The financial and climate-based barriers found in our sample were largely consistent with barriers found in previous work, suggesting these barriers may be common for families with young children (Irwin et al., 2005, Hardy et al., 2010). The most commonly reported barrier was related to winter weather. This barrier is unique to our sample because of the climate in the Northeastern region in which they live, where winter can last for many months. Families noted that the colder temperatures and shorter days during the winter makes it more difficult for their children to be active. The finding of winter as a barrier to PA is consistent with findings that warmer weather is more likely than colder weather to facilitate engagement in PA (Irwin et al., 2005). *Kiddie CATs at Home* addresses this barrier and can be done in the home in cases of inclement weather. It is also important to note that about one-fourth of the sample reported there were no barriers to their children's PA.

Access to PA equipment, access to places to be physically active in the community, having peers to engage with, family playmates, external motivators (i.e., rewards), children being self-motivated, structured PA opportunities, and outdoor activities were all reported by parents in this population as facilitators to their children's PA. Previous research has found that when outside, preschoolers are more likely to engage in MVPA (Cerin et al., 2016), which is consistent with our findings that parents reported outdoor activities as facilitators to their children's PA. Additionally, family playmates and external motivators being noted as facilitators to children's PA is consistent with previous findings that parental support increases children's PA behavior (Trost et al., 2003; Lindsay, Wasserman, et al., 2018). The children in our sample are involved in many different types of PA opportunities outside of school (indoor, outdoor, structured, unstructured, equipment-dependent, equipment-independent) and parents reported a wide variety of facilitators to their children's PA. It is important to note that outside of school PA

opportunities and motivators may vary for every family because of factors including access to equipment, safe and open outdoor spaces, and ability to join structured PA classes. Additionally, the children in our sample do not seem to engage in as many indoor activities, which is problematic, considering winter weather was reported as a barrier to outdoor PA. Although further study is necessary, this could mean children are not engaging in adequate levels of PA in the colder months because they prefer outdoor activities. In light of this, *Kiddie CATs at Home* may be an engaging alternative to outdoor play for this sample.

The *Kiddie CATs at Home* intervention presented here extends previous literature in this area, as very few studies have been done on the use of a video-based intervention for preschool children. Findings by Levin and colleagues (2002) and Obeng (2009) suggest the potential for videos to promote preschool PA and the need for more age-appropriate PA videos. Additionally, previous work suggests the strengths of PA interventions utilizing mass media are their accessibility and ability to reach a large number of individuals (Lau et al., 2011). However, mass media interventions have also been found to be less personal for consumers (Lau et al., 2011). In light of these findings, *Kiddie CATs at Home* blends the ease of an online platform with personalized instruction, combining the most beneficial aspects of both mass media and in-person interventions.

A notable strength of this study was the consistency between home and school interventions, as the home-based intervention utilized structure, activities, and trained instructors from the established school-based intervention. Parent responses highlight that the consistency between these interventions helped preschoolers to develop a personalized connection between home and school PA. The *Kiddie CATs at Home* intervention is unique, as it combines in-school, in-person instruction with an at-home video intervention and is accessible on any internet

platform. Additionally, *Kiddie CATs at Home* is free and accessible as long as families have access to an electronic device, transcending many of the previously mentioned barriers. An additional strength of the study was the racially and ethnically diverse sample, allowing for greater generalizability to a larger population of preschool children.

Findings of the present study should be considered in light of some limitations, including cultural and language barriers. Our questionnaire may not have been fully accessible for non-English speaking families, as answers revealed parents may have had issues understanding some of the questions about their children's home health behaviors. Future work should attempt to include translators or other methodologies that are not dependent on language and could provide information about PA behavior (e.g., accelerometry, direct observation). Additionally, a few parents noted issues accessing the videos, suggesting further work needs to be done in terms of accessibility, advertising, and interfacing with parents to develop the intervention in ways that make it work best for all families. Furthermore, our sample ( $n = 42$ ) may have lacked the power to detect some associations among the variables studied. Likewise, the sample of families that had children who watched the videos ( $n = 17$ ) also may have been too small to draw conclusions about the effectiveness of *Kiddie CATs at Home*. Although the preschoolers in this study came from both rural and small urban areas, the generalizability of our study may be limited, as our sample came from schools in a single state. Future work should consider a larger, more geographically diverse sample. Furthermore, the correlational nature of this study does not allow us to establish causality. Future research should utilize control groups to fully realize the implications of this intervention.

This study highlights the potential for video-based PA interventions to engage preschool children in PA in the home. Importantly, findings revealed that all children in this sample

exhibited some level of enjoyment while watching the *Kiddie CATs at Home* videos and on average, were active. These findings demonstrate the potential for the pilot program, *Kiddie CATs at Home*, as an intervention, especially given the need for novel PA interventions for preschool children.



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Table 1

*Means, Standard Deviations, and Intercorrelations among Study Variables*

Variable	1	2	3	4	5	6	7	8	<i>M</i>	<i>SD</i>
1. Did child watch <i>Kiddie CATs</i> at Home videos?	--	-.02	.19	.23	-.02	-.14	.24	.30	.40	.50
2. Age		--	-.22	-.27	.22	.06	-.03	-.14	3.98	.59
3. Sex <sup>a</sup>			--	.31*	-.24	.20	.05	.18	1.48	.51
4. Head Start Status				--	.35*	.26	.18	.09	.76	.43
5. School day screen use					--	.47**	-.04	-.06	1.90	.83
6. Weekend screen use						--	-.10	.03	2.24	.77
7. Average hours slept on weekdays							--	.60**	10.77	.92
8. Average hours slept on weekends								--	10.97	.87

Note: <sup>a</sup>1 = boys, 2 = girls Significance level of correlations are indicated as \* $p \leq .05$ , \*\* $p \leq .01$

Table 2

*Percentage of Parents who Endorsed Each Category of Child Screen Time Usage for School and Weekend Days*

Type of Day	Category of Child Screen Time Usage				
	0 Hours	Less than 1 Hour	1 – 2 hours	3 – 4 Hours	5 or More Hours
School Day	2.4%	28.6%	45.2%	19%	2.4%
Weekend Day	0%	11.9%	57.1%	21.4%	7.1%