Physical activity levels of early childcare education (ECE) providers are associated with physical activity policies and practices in ECE centers

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Abstract

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Background: Early childhood education (ECE) educators may play an influential role in developing the physical activity (PA) habits of the children in their care. Studies exploring early childhood education (ECE) providers' physical activity (PA) levels and whether they influence PA in ECE centers are lacking. This study aims to fill that gap by describing the PA levels of ECE providers, exploring the relationship between provider PA level and the PA policies and practices within their centers, and investigate any relationships between provider PA levels and their mental health status.

Methods: In this cross-sectional study, 366 ECE providers from 49 ECE centers located in Seattle, South King County, and Austin, TX were surveyed to assess physical activity levels, physical activity policies and practices within their ECE centers, and self-reported mental health status. Scoring from the International Physical Activity Questionnaire (IPAQ) was used to describe the PA levels of ECE providers as low, moderate and high and in MET minutes. The Nutrition and Physical Activity Self-

Assessment for Child Care (NAP SACC) was used to measure center-level PA policies and practices for children enrolled in ECE centers. Scores for NAP SACC subsections were separated by those caring for infants and those not, as some questions related only to centers with infants (e.g. tummy time). Providers' mental health status was assessed using self-reported Center for Epidemiologic Studies Depression Scale (CES-D) and Perceived Stress Scale (PSS) questionnaires. Linear regression and ANOVA were performed to characterize possible relationships among provider PA levels with PA policies and practices of the ECE centers and provider PA levels with their mental health status.

Results: Forty-eight percent of ECE providers had 'Moderate' PA levels (N= 171), followed by 'High' PA levels (38%; N= 138) and 'Low' PA levels (14%; N= 51). MET minutes were directly associated with total scores on the NAP SACC 'Outdoor Play & Learning' subsection in centers with infants ($R^2 = 0.014$, $p= 0.049$). This association remained after adjusting for geographic site ($p= 0.041$). Controlling for site suggested additional associations between MET minutes and NAP SACC scores on 'Physical Activity' (with infants, $p=<0.001$), 'Play Time' (with infants, $p<0.001$), 'Teacher Practices' (with infants, $p<0.001$), 'Outdoor Play Time' (with infants, $p=0.038$; without infants, $p <0.001$), 'Education & Professional Development' (all centers, $p=0.038$) and 'Outdoor Play Environment' (all centers, $p=0.004$). When PA levels were considered categorically, NAP SACC 'Outdoor Play Time' scores in centers without infants were significantly lower for providers classified as having low levels of PA (3.13 ± 0.377) compared with scores for providers with high PA levels (3.41 ± 0.246, $p=0.035$). MET minutes were also inversely associated with CESD-R scores ($p <0.001$) and PSS scores ($p=0.002$) after controlling for provider's age.

Conclusion: Our findings suggest that ECE provider PA levels are associated with best practices in some subsections of the arenas of *Physical Activity* and *Outdoor Play and Learning* as assessed by the NAP SACC survey. Furthermore, provider PA levels and mental health status were inversely associated. Future research should consider interventions that increase support for ECE providers in improving their own

physical activity, as this may have an effect on both their health and well-being, and on the health behaviors of children in their centers.

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Introduction

Approximately 60% of children in the U.S. who are under 6 years old and not enrolled in kindergarten, receive regular childcare from a non-parent.[1] Of those children, 41% are in the care of another relative, 22% are cared for in a home-based setting, and 59% receive early childhood education (ECE) center-based care.[1,2] Children receiving care in ECE centers may spend a majority of their day with these providers who have the potential to impact their future health behaviors.[3] However, little is known about how ECE providers' personal lifestyle habits, health-related values, and attitudes toward health behaviors might influence policies and practices within ECE centers. Examining ECE provider health behaviors and the existing health culture in ECE centers may provide insight for interventions to best support providers and perhaps the children cared for by them.

Physical Activity and Health Status in Childcare Workers

The U.S. Department of Health and Human Services (US DHHS) has recommended adults participate in at least 150 minutes, or 2 hours and 30 minutes, of moderate-intensity physical activity per week to reduce the risk of chronic disease development and premature death.[4–6] These guidelines translate into $\geq$ 500 metabolic equivalent (MET) minutes per week. MET minutes are units used to measure energy expenditure across different types of activities (see Table A in 'Appendix'). One MET minute is the equivalent of one calorie per kilogram.[4–6] Studies have shown that adults who met these physical activity guidelines reduced their risk of falls, cancers, and chronic disease development. Further benefits included improved brain and mental health, functional capacity, and muscle strength and endurance.[4,5]

A 1996 study conducted in Wisconsin found 38% of ECE providers reported participating in physical activity (PA) three or more times per week compared to 47% of adults statewide. Many included physical demands performed on the job in weekly PA reports. Additionally, 43% of the sample reported PA once weekly or not at all.[7]

Historically, wages in childcare are low, with approximately 42% of providers living below the poverty level.[8] This population is reported to experience low perceived health and increased health risks, including lower PA levels and higher depressive symptoms, which may be associated with low wages,

high stress, and physical demands of the profession.[8–11] Health of ECE providers has been a primary factor in the retention of workers, as well as the quality of care provided within centers.[7] Teachers in ECE centers had a greater occupational risk of absences due to illness and physical demands compared to center directors.[7,8] Though, center directors reported higher overall job demands and longer work days.[7,8]

Recent evidence from the UK suggested increases in the national minimum wage resulted in improvements in health status and health conditions in the general population. This may have been attributed to changes in health behavior, leisure time activity, and lowered financial stress.[12] The California Teachers Study recognized low SES was associated with lower PA levels.[10] Age may also play a role, with significant correlations found between lower age and greater healthy lifestyle.[13]

In the general workforce, studies investigating workplace promotion of recreational PA and overall PA levels have favorable results, suggesting that these interventions have a positive effect on total PA levels. Employers who incorporate worksite promotion of PA may have the ability to increase employee leisure-time PA levels.[14] A 2011 study of worksites with higher promotion of PA found associations with higher overall employee PA levels.[14] The Women of the Sister Study found that low occupational activity was associated with lower leisure-time PA.[15]

There is evidence to suggest that increasing PA is beneficial for the management of mild-to-moderate depression and anxiety.[9,16] However, when examining workplace physical demands and mental health, higher workplace physical demands are correlated with a greater level of stressors on mental health.[9,14] This suggests that the domain in which PA is performed may be important, with the greatest mental health benefits coming from leisure-time PA.[9,11]

Physical Activity in Child Care Centers

Encouraging PA is beneficial for growth and development in children.[17,18] Children enrolled in the same ECE center as their peers experienced drastically different gross motor experiences based on their assigned provider, suggesting that the childcare environment was a contributor to PA levels.[19–22] ECE providers often perceived the amount of active time children engage in to be higher than what has been observed.[23,24] In fact, children in ECE centers often spend anywhere from 40-80% of their day

engaged in sedentary activities, an average of 30% of their day standing, and less than 20% of their day engaging in PA.[23,24]

Children with 60+ minutes of outdoor time have higher levels of PA than their counterparts with less access to outdoor time. Though, outdoor play time occurred less often in ECE centers than daily schedules reported.[19] A systematic review of 39 studies from 1986-2007 found 46% of children under 6 years old were meeting current PA guidelines for their age group.[17] Females in ECE centers were particularly at-risk for low levels of PA[18,25,26] and experienced an even further decline in PA levels from ages 6-9 years old.[26] Low levels of PA in childhood have been shown to follow through adolescence and adulthood without intervention.[18,25,26] These findings have suggested that PA policies and practices implemented in ECE centers may have a lifelong impact on a child's PA levels and health outcomes later in life.

While parents play a primary role in influencing PA levels of preschoolers,[27] the influence of ECE providers on a child's PA level is not completely understood. ECE providers' own experiences with PA, perceived benefits, and personal attitudes toward physical activities and outdoor exposure were major potential barriers to PA within ECE settings.[8,19,20,22] Additional barriers lie in perceptions that the provider role is to offer care and not necessarily influence healthy lifestyle behaviors.[28] Furthermore, ECE providers' personal struggles to maintain healthy lifestyle habits were additional impediments to health behavior promotion with students.[3,28–32]

ECE providers have the potential to influence future health behaviors of young children, contribute to the overall health environment, and improve quality of care within ECE centers. Therefore, this study aimed to:

1. Describe physical activity (PA) levels of ECE providers,
2. Examine how provider PA levels associate with center-level PA practices and policies for children in ECE centers, and
3. Investigate relationships between provider PA level and self-reported mental health status

Methods

This cross-sectional study analyzed baseline data collected as part of the "Exploring the Effects of Wage on the Culture of Health in Early Childhood Education Centers" prospective cohort study. The overarching aim of the ongoing project is to examine the effect of wage changes on educator health and the overall quality of ECE centers and their environments over the next 3 years.[33]

Sample recruitment and Data collection

ECE providers in Seattle, WA, South King County WA, and Austin, TX were enrolled in the study from August 2017 to December 2017. ECE centers were identified through Childcare Aware of America where center name and contact information were obtained. Center inclusion criteria included centers providing care to children 0-6 years old. Exclusion criteria included Head Start programs and in-home centers, as these programs and the populations they serve would make comparisons among the sample challenging. Head Start is a federal program requiring adherence to specific educational, health, and social support programming which may have influenced the results of the study. In-home centers also operate under appreciably different policies and practices.

Center directors were contacted by email with information about the study. Directors who expressed interest were contacted by the study's research coordinator via phone to enroll in the study. Email non-respondents were followed up with by mail and phone. At the time of enrollment, 49 ECE centers were recruited to the study.[33]

Center directors were provided with the Nutrition and Physical Activity Self-Assessment for Child Care (NAP SACC) survey to complete, answering questions related to nutrition and PA best practices. Center staff met in-person with study staff to learn about the study, obtain participant consent, and acquire contact information. Staff inclusion criteria included any full- or part-time staff with direct interaction with children at the center and adequate English proficiency to obtain consent and complete the survey. At enrollment, 504 staff members were emailed or mailed a survey that included validated questionnaires. The tools included in this study inquired about staff demographic information, employment, mental health, and physical activity.

Study Measures

Demographic, employment, and self-reported health information was obtained through ECE provider surveys. Self-reported health measures analyzed from the provider survey included the International Physical Activity Questionnaire (IPAQ), Center for Epidemiologic Studies Depression Scale- Revised (CESD-R), and Perceived Stress Scale (PSS). Center directors completed the NAP SACC and scores were then matched with staff within their ECE centers.

IPAQ (International Physical Activity Questionnaire)

The IPAQ questionnaire was developed by the International Consensus Group and pilot tested between 1997 and 1999. There are 8 versions, 4 short form and 4 long versions, which can be administered by interview or self-administration.[34,35] IPAQ results can be represented as a continuous variable (total MET minutes per week) or categorical variable (low-, moderate- and high PA levels). Weekly MET minutes were calculated in the following format:

- MET minutes = *MET value* x *duration of activity (minutes)* x *number of days per week*.

Activities lasting <10 minutes were excluded.[35] Participants were categorized into low, medium, and high physical activity levels based on IPAQ scores. ECE providers meeting criteria for "low physical activity level" were deemed at-risk for suboptimal PA. Additionally, total MET minutes and MET minute domains (leisure, home, transport, and work) were included in this study. Examples of MET values for different physical activities can be found in Table A in the Appendix. PA categories were determined by the following criteria:

- *High*- equivalent of one-hour of at least moderate-intensity activity per day
    - At least 3 days vigorous-intensity activity per week totaling ≥1500 MET minutes; or,
    - 7 days of walking, moderate- or vigorous- intensity activity in any combination totaling ≥ 3000 MET minutes
- *Moderate*- equivalent of half an hour of at least moderate-intensity activity per day
    - At least 3 days vigorous-intensity activity and/or walking 30 minutes/day; or,
    - At least 5 days of moderate-intensity activity and/or walking 30 minutes/day; or,

    - At least 5 days of walking, moderate-, or high-intensity activity totaling > 600 MET minutes per week

- *Low* – does not meet criteria for 'Moderate' or 'High' PA levels[35]

The IPAQ is a valid and reliable measure of physical activity compared with other self-reported physical activity questionnaires.[34,36] One study conducted in 2003, tested the reliability and validity of all IPAQ forms in 12 countries across 14 centers.[34] Another study in 2018, explored the validity of the long-form IPAQ in older adults.[36] In both studies, participants completed the IPAQ while also wearing a CSA motion detector[34] or Actigraph GT3X accelerometers.[36] There was moderate agreement with overall IPAQ data when compared with motion detector/accelerometer recorded physical activity.[34,36]

NAP SACC (Nutrition and Physical Activity Self-Assessment for Child Care)

The NAP SACC is a validated 45-question survey developed by the University of North Carolina at Chapel Hill Frank Porter Graham Child Development Center. It is intended for childcare providers to use as a tool for self-assessment of nutrition and physical activity environments within their centers. The NAP SACC measures dietary frequency of food groups and beverages and measures implementation of nutrition and physical activity best practices in the center using a 4- point Likert scale. A score of 4 indicated the best practice was met.[21]

Self-assessment of PA and nutrition policy and practices through use of the NAP SACC survey has been correlated with improved best practices within centers. For instance, at baseline, Battista et al. found ECE centers reported meeting 95% of NAP SACC recommendations. Following completion of the pre-test NAP SACC, goal-setting, and nutrition and PA workshops over 6 months, centers improved in an average of 5 of 37 nutrition and 7 of 17 PA best practices on the post-intervention NAP SACC.[37]

This study employs subsections of the NAPSACC, completed by center directors, and related to PA and outdoor play within ECE centers. Average scores of these subsections were compared to the best practice score. Several subsection scores were separated by centers who care for infants and centers who do not care for infants due to items within these sections pertaining to only those centers who care for

infants. Topics included items related to tummy time and frequency of infants taken outdoors during the week.

CESD-R (Center for Epidemiologic Studies Depression Scale- Revised)

The CESD-R, developed in 1977 and revised in 2004, is a validated self-reported mental health questionnaire designed to measure depressive symptoms within the general population. Other tools are used to measure depressive symptoms at intake or at different points throughout mental health treatment. However, CESD-R is a scale intended to be used in studies, such as this one, to assess relationships in a sample population between depression and other variables. The 20-item scale probed participants about feelings and behaviors exhibited over the week prior to the assessment, rated on a scale that corresponded to a number score as follows:

- *Not at all or less than 1 day = 0*
- *1-2 days = 1*
- *3-4 days = 2*
- *5-7 days = 3*
- *Nearly every day for 2 weeks = 3**[38–40]

(*The original CESD rated this as 4 in scoring, but to match the original scale the CESD-R scores the last 2 categories the same.[40])

Items of the CESD-R related to 9 major symptoms of depression: sadness/dysphoria, loss of interest/anhedonia, appetite, sleep, thinking/concentration, guilt/worthlessness, tired/fatigue, movement/agitation, and suicidal ideation. Scores were analyzed by symptom subcategories to give an overall 'style score.' Categorical scoring criteria included the following:

- *Meets criteria for major depressive episode* – Rating questions related to sadness and loss of interest as *'Nearly every day for 2 weeks'* and having symptoms in 4 or more symptom groups '*Nearly every day for 2 weeks'*

- *Probably major depressive episode* - Rating questions related to sadness and loss of interest as '*Nearly every day for 2 weeks'* and having symptoms in 3 or more symptom groups '*Nearly every day for 2 weeks'* or '*5-7 days'* in the last week
- *Possible major depressive episode* - Rating questions related to sadness and loss of interest as '*Nearly every day for 2 weeks'* and having symptoms in 2 or more symptom groups '*Nearly every day for 2 weeks'* or '*5-7 days'* in the last week
- *Subthreshold depression symptoms* – Does not meet previous criteria, but style score of at least 16
- *No clinical significance* – Total style score of less than 16[40]

This study utilized CESD-R categorical breakdown in the sample population and the total style score as a continuous variable.

PSS (Perceived Stress Scale)

The PSS is an adequately valid and reliable measure of psychological stress a person experiences relative to their ability to cope with such situations. It consisted of 14 items related to thoughts and feelings over the prior month, which participants score as: *0 = never; 1 = almost never; 2 = sometimes; 3= fairly often; and 4 = very often.* Seven items were scored regularly and 7 positively phrased items were reverse-scored (0=4, 1=3, 2=2),[41] then summed to provide the total score out of 56. Higher scores were associated with higher perceived stress and categorized as:

- *Low stress = <20*
- *Moderate stress = 20-36*
- *High stress = >36*[33]

We employed the PSS total score as a continuous variable and also looked at categorization based on score in analyses.

Data Analysis

Analysis was performed using IBM SPSS Statistics 19.0 (IBM Corp, Armonk, NY). Descriptive summary statistics were determined for demographic and characteristic information, self-reported

physical activity levels, NAP SACC scores, and self-reported mental health status in the total sample population and by geographic location. Differences in physical activity levels and/or geographic location were tested using Chi-square and ANOVA. Multiple linear regression was performed to assess relationships between total MET minutes per week and scores on NAP SACC survey, as well as self-reported mental health status, with adjustments for geographic location, age, income, gender, job title, and duration of time working in ECE centers.

Results

Forty-nine ECE centers were enrolled in the study by ECE center directors. Directors completed the NAP SACC survey on behalf of their ECE centers, providing information about nutrition and PA policies and practices. Upon initial recruitment, 504 ECE providers indicated interest in participating in the study. The final study included 366 ECE providers who returned completed provider surveys, by mail or email, from September 2017 to January 2018. Of these providers, 144 (39%) were from Seattle, WA, 98 (27%) were from South King County, WA (SKC), and 124 (34%) were from Austin, TX. Table 1 provides a summary of study participant characteristics.

Sample Characteristics

Of participants in this study, 341 (93.2%) were female, the remainder indicated male (n=22; 6%), other (n=2; <1%), or provided no answer (n=1; <1%). Participants' ages ranged from 18-79 years old, with a mean of 37 ± 13.03 year. There were no differences in age among the 3 geographic locations (Seattle, SKC, and Austin, TX). Sixty-nine percent of participants in the total sample population were non-Hispanic white, with Seattle having a significantly lower proportion of Hispanic participants (n= 13; 9.0%, $p< 0.001$) compared to SKC (n= 23; 23.5%) and Austin, TX (n= 40; 32.3%).

The average self-reported hourly wage in Seattle was significantly higher ($16.75 ± 2.43/hour, $p< 0.001$) than both SKC ($13.76 ± 2.87/hour) and Austin, TX ($14.17 ± 7.05/hour). Within their ECE centers, SKC (63 ± 29.34, $p<0.05$) had an average of 15 less children enrolled in their centers compared to Seattle (79 ± 36.63), and 14 less children enrolled than Austin, TX (77 ± 47.46).

Table 1. Sample demographics and characteristics of total sample and by geographic location

	All (N = 366)	Seattle, WA (N = 144)	South King County, WA (N = 98)	Austin, TX (N = 124)
Gender				
Female	341 (93.2%)	127 (88.2%)	95 (96.9%)	119 (96.0%)
Male	22 (6.0%)	15 (10.4%)	3 (3.1%)	4 (3.2%)
Other	2 (0.01%)	2 (1.7%)	-	-
Ethnicity				
Hispanic	76 (20.8%)	13 (9.0%)*	23 (23.5%)	40 (32.3%)
Non-Hispanic	282 (77.0%)	128 (88.9%)	75 (76.5%)	79 (63.7%)
American Indian/Alaska Native	12 (3.3%)	6 (4.2%)	4 (4.1%)	2 (1.6%)
Asian	29 (7.9%)	22 (15.3%)*	6 (6.1%)	1 (0.8%)
Black/African American	53 (14.5%)	17 (11.8%)	15 (15.3%)	21 (16.9%)
Native Hawaiian/Pacific Islander	4 (1.1%)	2 (1.4%)	1 (1.0%)	1 (0.8%)
White	253 (69.1%)	102 (70.8%)	67 (68.4%)	84 (67.7%)
Other	20 (5.5%)	10 (6.9%)	5 (5.1%)	5 (4.0%)
Age, Mean *(SD)*	37.02 *(13.03)*	36.93 *(36.93)*	35.98 *(13.80)*	37.94 *(13.47)*
BMI, mean (*SD*)	29.08 *(8.51)*	27.90 *(6.71)*	30.07 *(8.34)*	29.68 *(10.22)*
Education				
Some high school	7 (1.9%)	2 (1.4%)	3 (3.1%)	2 (1.6%)
High school graduate/GED	59 (16.1%)	16 (11.1%)	25 (25.5%)	18 (14.5%)
Some college in ECE, no degree	60 (16.4%)	14 (9.7%)	23 (23.5%)	23 (18.5%)
ECE Certificate	19 (5.2%)	5 (3.5%)	7 (7.1%)	7 (5.6%)
Associate's degree in ECE	38 (10.4%)	16 (11.1%)	11 (11.2%)	11 (8.9%)
Associate's degree, other	15 (4.1%)	6 (4.2%)	3 (3.1%)	6 (4.8%)
Bachelor's degree, ECE	41 (11.2%)	13 (9.0%)	7 (7.1%)	21 (16.9%)
Bachelor's degree, other	88 (24.0%)	55 (38.2%)	9 (9.2%)	24 (19.4%)
Master's degree in ECE	10 (2.7%)	2 (1.4%)	-	8 (6.5%)
Master's degree, other	17 (4.6%)	11 (7.6%)	4 (4.1%)	2 (1.6%)
Other	17 (4.6%)	4 (2.8%)	4 (4.1%)	2 (1.6%)
Primary language				
English	305 (83.3%)	121 (84.0%)	77 (78.6%)	107 (86.3%)
Spanish	31 (8.5%)	4 (2.8%)	14 (14.3%)	13 (10.5%)
Other	27 (7.4%)	18 (12.5%)	7 (7.1%)	2 (1.6%)
Household income				
<$20,000-39,999	160 (43.7%)	68 (47.3%)	48 (49.0%)	44 (35.4%)
$40,000-74,999	105 (28.7%)	34 (23.7%)	23 (23.5%)	48 (38.7%)
$75,000+	75 (20.5%)	34 (23.6%)	16 (16.3%)	25 (20.2%)
Hourly Rate, Mean *(SD)***	15.12 *(4.49)*	16.75 *(2.43)**	13.76 *(2.87)*	14.17 *(7.05)*
Job Title				
Center Director	29 (7.9%)	7 (4.9%)	5 (5.1%)	17 (13.7%)
Program Coordinator	17 (4.6%)	7 (4.9%)	4 (4.1%)	6 (4.8%)
Lead Teach/Instructor	122 (33.3%)	43 (29.9%)	38 (38.8%)	41 (33.1%)
Teacher/Instructor	95 (26.0%)	44 (30.6%)	23 (23.5%)	28 (22.6%)
Asst. Teacher/Instructor	78 (21.3%)	33 (22.9%)	19 (19.4%)	26 (21.0%)
Other	25 (6.8%)	10 (6.9%)	9 (9.2%)	6 (4.8%)
Number of Children at ECE center, mean (*SD*)	74 *(39.85)*	79 *(36.63)*	63 *(29.34)**	77 *(47.46)*
Duration in ECE, mean (*SD*)	10.00 *(9.65)*	9.38 *(8.81)*	8.47 *(9.42)*	11.92 *(10.48)*
< 1 – 10 years	240 (65.4%)	102 (70.9%)	67 (68.4%)	71 (57.1%)
11-20years	72 (19.6%)	25 (17.5%)	18 (18.4%)	29 (23.2%)
20+ years	53 (14.5%)	17(11.9%)	12 (12.2%)	24 (19.3%)

* p<0.05 comparing groups (Seattle, SKC, Austin) using ANOVA and post-hoc Tukey test for multiple comparisons

** 2 observations dropped due to hourly rate likely entered by study participant in error

Physical Activity Levels

To assess PA levels, IPAQ data for 360 participants was analyzed; six participants were excluded from calculations due to daily reported minutes from walking, moderate, and vigorous activities exceeding the maximum 960 minutes. Figure 1 displays provider physical activity levels based on IPAQ criteria for low, medium, and high physical activity levels. Within the total sample, 14% met criteria for low, or suboptimal PA levels. By geographic location the distribution was similar to that seen in the total sample. However, Austin, TX had the highest proportion of ECE providers with suboptimal PA levels at 17% compared to Seattle (13%) and SKC (11%).

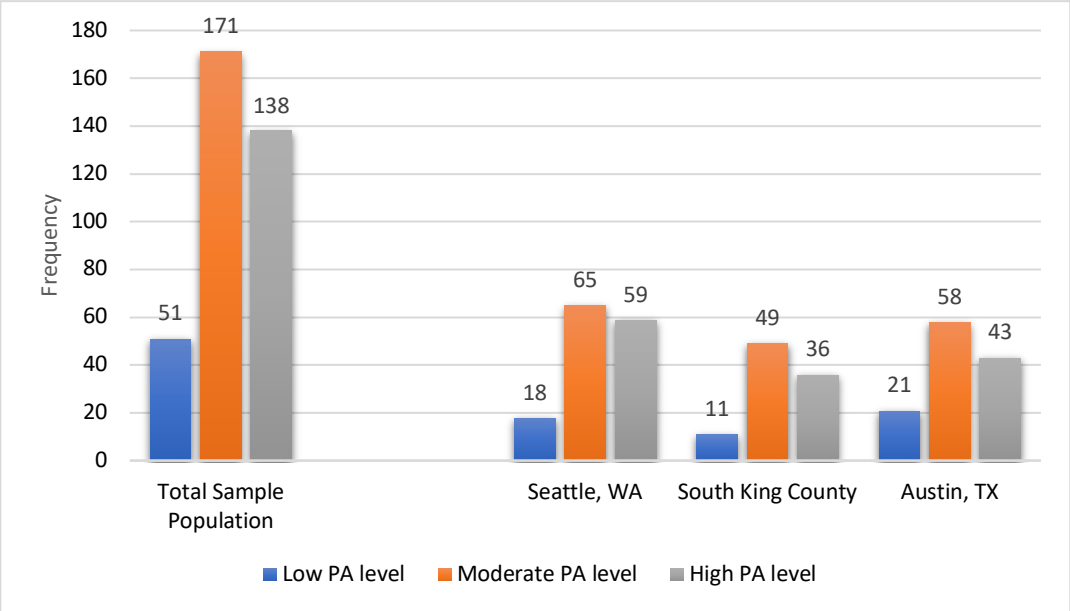

Figure 1. Frequency of physical activity levels (low, medium, and high) as categorized by the IPAQ – total sample population and by geographic location

The overall average of ECE provider MET minutes (METs) was 3476 ± 3803.No significant differences in METs were found by site: providers in Austin, TX averaged 3803 ± 5120; providers in Seattle averaged 3433 ± 3363; and providers in SKC averaged 3130 ± 2812. Total METs were separated by IPAQ domain (work, transport, domestic, and leisure), with work METs accounting for the largest proportion (54%) of the total (Figure 2).

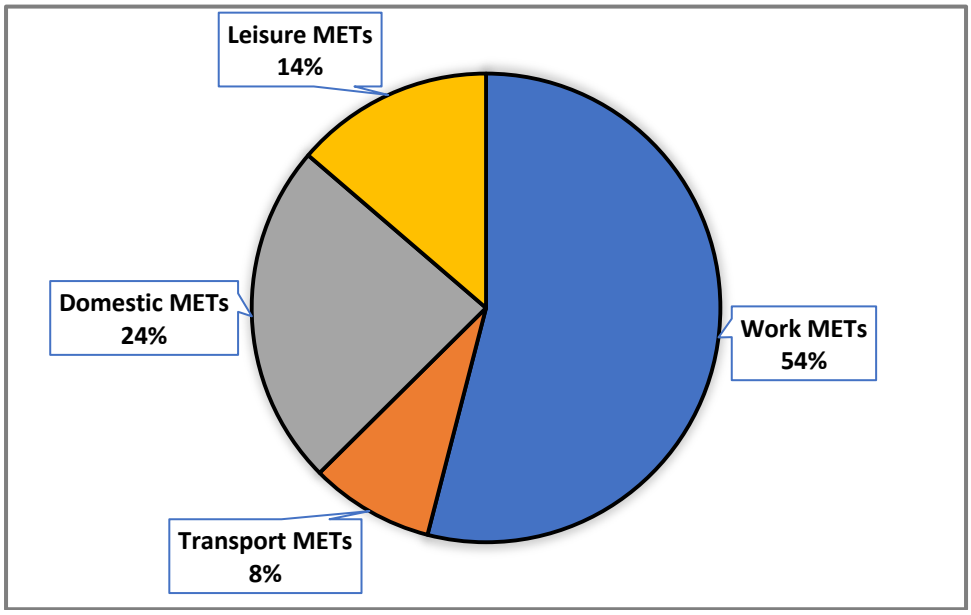

Figure 2. Proportion of Total MET minutes by domain (work, transport, domestic, and leisure)

SKC had approximately 200 transport METs less than Seattle (p = 0.04). Differences were also found in leisure METs whereby ECE providers in SKC had an average 289 fewer leisure METs than Seattle ECE providers (p=0.024). Austin, TX had 174 fewer leisure METs than Seattle, though this difference was not significant. Total METs and domain (leisure, home, transport, and work) METs by job title were not different across the 3 geographic locations.

ECE Center Physical Activity Level Policies and Practices

NAP SACC data analyzed in this study included average best practice scores on the 'Physical Activity' and 'Outdoor Play & Learning' sections and their respective subsections. Several subsections have been separated into centers who care for infants (N=278; 77%) and those who do not provide infant care (N = 82; 23%), as these sections had several items pertinent only to centers who care for infants. Table 2 presents the proportion of ECE centers that met the best practice score of '4' on NAP SACC subsections. The largest proportion of centers meeting the best practice score was found in 'Teacher Practices' related to PA, in both centers with infants (71%) and without infants (69%). The best practice score was not met by ECE centers without infants in the areas of overall 'Physical Activity' and 'Outdoor

Play & Learning,' due to lack of centers meeting the best practices in 'Time Provided' and 'Outdoor Play Time' in both sections. The 'Outdoor Play Environment' section had the lowest proportion of centers of the sections that had any best practices met.

Table 2. Proportion of ECE centers meeting the best practice score* on Physical Activity & Outdoor Play NAP SACC subsections in the total sample population

	Infants (N = 278)	*No infants* (N= 82)
Physical Activity	11.2%	--
Time Provided	25.6%	--
Indoor Play Environment	40.4%	48.5%
Teacher Practices	70.9%	69.0%
Education & Professional Development	11.5%	
Policy	30.5%	
Outdoor Play & Learning	2.1%	--
Outdoor Play Time	31.1%	--
Outdoor Play Environment	1.2%	
Education & Professional Development	12.2%	
Policy	34.7%	

* Best practice score is equal to 4 (on scale of 1-4)

Table 3 shows the average ECE center scores on NAP SACC subsections for centers without infants according to IPAQ PA classification. Significant differences in NAP SACC 'Outdoor Play Time' and 'Indoor Play Environment' scores were revealed such that 'Outdoor Play Time' scores were significantly lower in those with low levels of PA (3.13 ± 0.377) compared to those with high PA levels (3.41 ± 0.246, $p=0.035$), and 'Indoor Play Environment' scores were also significantly lower in those with low PA levels (2.92 ± 0.878) compared to those with high PA levels (3.44 ± 0.393, $p=0.047$).

When centers with and without infants were considered collectively, provider MET minutes were associated with NAP SACC scores in the Outdoor Play & Learning subsections 'Education & Professional Development' ($\beta= 0.109$, $p=0.038$,) and 'Outdoor Play Environment' ($\beta= 0.152$, $p=0.004$).

In centers with infant care, analysis of MET minutes revealed a direct association between MET minutes and NAP SACC scores in the 'Outdoor Play & Learning' subsection ($R^2=0.014$, $p=0.049$). After adjusting for geographic location, additional associations between total MET minutes and NAP SACC scores in the 'Physical Activity' ($\beta= -0.224$, $p <0.001$,) and 'Outdoor Play & Learning' ($\beta= 0.122$, $p= 0.041$) sections. Within these NAP SACC sections, MET minutes were associated with 'Time Provided'

(β=0.-317, p <0.001), 'Teacher Practices' (β= -0.347, p <0.001), and 'Outdoor Play Time' (β= 0.125, p= 0.038). Likewise, and association between MET minutes and 'Outdoor Play Time' was revealed in centers without infant care after adjusting for geographic location (β= -0.540, p <0.001).

Table 3. Average ECE center scores in Physical Activity and Outdoor Play & Learning NAP SACC subsections in the total population and by IPAQ PA level category in centers without infant care**

NAP SACC Sections NAP SACC subsections	Total M ± SD	Low PA levels M ± SD	Moderate PA levels M ± SD	High PA levels M ± SD
Physical Activity	2.98 ± 0.60	2.85 ± 0.74	2.30 ± 0.56	3.04 ± 0.59
Time Provided	2.49 ± 0.71	2.33 ± 0.74	2.52 ± 0.67	2.53 ± 0.75
Indoor Play Environment	3.30 ± 0.62	2.92 ± 0.88	3.27 ± 0.66	3.44± 0.39*
Teacher Practices	3.59 ± 0.35	3.50 ± 0.48	3.60 ± 0.35	3.61 ± 0.32
Education & Professional Development	3.10 ± 0.65	3.00 ± 0.64	3.11 ± 0.64	3.12 ± 0.66
Policy	2.90 ± 0.95	2.91 ± 0.99	2.85 ± 0.92	2.96 ± 0.99
Outdoor Play & Learning	2.99 ± 0.70	2.85 ± 0.80	3.07 ± 0.68	2.94 ± 0.71
Outdoor Play Time	3.36 ± 0.32	3.13 ± 0.38	3.37 ± 0.33	3.41 ± 0.25*
Outdoor Play Environment	3.07 ± 0.47	3.09 ± 0.49	3.05 ± 0.47	3.09 ± 0.46
Education & Professional Development	2.91 ± 0.80	2.82 ± 0.86	2.92 ± 0.79	2.94 ± 0.79
Policy	3.13 ± 0.79	3.10 ± 0.81	3.12 ± 0.77	3.14 ± 0.81

**Scoring: 1-4

* p<0.05 comparing groups using ANOVA and post-hoc Tukey test

Mental Health Status and Physical Activity

The CESD-R survey assessed the level of depressive symptoms in ECE providers. Higher scores (0-60) represent higher depressive symptomology. In the total sample population, 353 participants completed the questionnaire (Seattle, n = 140; SKC, n = 98; Austin, TX, n = 121). The average score on the CESD-R for all ECE providers was 15.86 ±10.95, indicating *'No clinical significance'* for depression. Average scores by geographic location were similar to the population mean (Seattle 15.39 ± 10.48, SKC 15.43 ± 11.98, and Austin, TX 16.56 ± 10.62).

The majority of ECE providers showed *'No clinical significance'* in symptoms of depression (59.3%; N = 213), followed by *'Subthreshold depression symptoms'* (33.4%; N= 120). There were slight differences in several proportions of CESD-R categories across physical activity levels (Table 4). Only 9

out of 359 providers (2.5%) fell within 'Meets criteria for a major depressive episode'. In the categories of 'Probably major depressive episode' and 'Subthreshold depression symptoms', ECE providers with high physical activity level scored marginally lower (2.9% n= 4 and 27.9% n= 38, respectively) compared to those in the low PA category (5.9% n= 3 and 35.3% n= 18, respectively). Additionally, there were larger proportions of ECE providers with high PA levels in the 'No clinical significance' category (64.0%; N= 87) compared to moderate (56.0%; N= 93) and low (56.9%; N= 29) PA level groups.

Assessment of MET minutes revealed an inverse association with CESD-R scores among ECE providers (β= -0.325, $p < 0.001$) after adjusting for age, so that higher METs were associated with lower CESD-R scores.

Table 4. Frequencies of CESD-R Categories – Total sample population and by PA levels

CESD-R Category	Total (N = 359)	Low PA levels (N = 51)	Moderate PA levels (N= 171)	High PA levels (N = 138)
Meets criteria for major depressive episode	9 (2.5%)	1 (2.0%)	3 (1.8%)	5 (3.7)%
Probably major depressive episode	14 (3.9%)	3 (5.9%)	7 (4.2%)	4 (2.9%)
Possible major depressive episode	3 (0.8%)	--	1 (0.6%)	2 (1.5%)
Subthreshold depression symptoms	120 (33.4%)	18 (35.3%)	62 (37.3%)	38 (27.9%)
No clinical significance	213 (59.3%)	29 (56.9%)	93 (56.0%)	87 (64.0%)

The average score on the PSS for all ECE providers was 23.58 ± 7.73, categorized as *'Moderate stress'* levels. Average scores across all geographic locations were similar to the total sample population (Seattle 23.55 ± 7.67; SKC 23.53 ± 7.83; Austin, TX 23.76 ± 7.67).

ECE providers with low PA levels had the highest proportion of *'High perceived stress'* among the 3 PA levels (9.8%; N= 5) and almost double that of the total population (5%; N=18) (Table 5). Providers with low PA levels also had the highest proportion of *'Low perceived stress'* (38.2%; N=20) compared to high PA levels (34.1%; N= 46) and moderate PA levels (30.8%; N= 52).

Table 5. Frequencies of PSS Categories – Total sample population and by PA levels

PSS Category	Total (N = 360)	Low PA levels (N = 51)	Moderate PA levels (N= 171)	High PA levels (N = 138)
High perceived stress	18 (5%)	5 (9.8%)	8 (4.7%)	5 (3.7%)
Moderate perceived stress	224 (62.2%)	25 (51.0%)	109 (64.5%)	84 (62.2%)
Low perceived stress	118 (32.8%)	20 (38.2%)	52 (30.8%)	46 (34.1%)

Relationships between MET minutes and scores on the PSS were found when adjusting for age (β= -0.230, p=0.002), suggesting that an increase in MET minutes may be associated with lower scores on the PSS. No additional associations were found between MET minutes and mental health status on the CESD-R and PSS after adjusting for possible confounding variables (gender, household income, geographic location, or duration within the field of ECE).

Discussion

The purpose of this study was to describe physical activity (PA) levels of ECE providers, examine how provider PA levels associate with center-level PA practices and policies for children in ECE centers, and investigate relationships between provider PA levels with self-reported mental health status. Our major finding was that ECE providers with high PA levels worked in centers that were more likely to report following best practices related to outdoor play time compared to ECE providers with low PA levels.

Physical Activity Levels

The US DHHS recommends adults meet or exceed 150 minutes of moderate-to-vigorous PA weekly, or ≥500 METs.[4,5] The national average in 2010 found over two-thirds of adults did not meet this recommendation[4,5] compared to 12% (N = 44) of participants in this study who self-reported <500 METs. While these numbers are largely different, criteria for measuring PA were different and we were limited by self-reported PA which was subject to recall and social-desirability bias.

ECE providers often include physical demands of the job in self-reported weekly PA.[7] Our findings accounted for this when using the IPAQ, which incorporates work PA into its scoring of weekly PA; the greatest contributor to total METs were work METs. Within the childcare workforce, those in administrative positions were less active and reported higher workplace demands than those in other positions.[8] However, we did not find any significant differences in PA levels by ECE job titles.

Interventions promoting healthful habits in ECE providers have been successful in improving provider self-efficacy in conveying health information, such as speaking to parents about the fruits and vegetables served at their centers.[42] There is potential to impact the health culture of the classroom by creating interventions promoting PA in ECE providers. Providers may place more attention on promoting these behaviors in children if they are working to improve their own health.[42]

ECE Center Physical Activity Level Policies and Practices

Our study found that ECE centers who do not care for infants did not meet best practices for both indoor and outdoor playtime. These findings appeared to be consistent with previous studies reporting PA

duration within ECE centers occurred less frequent than reported on schedules.[19] Teacher practices in PA were found to have the highest proportion of best practices met in our study, which includes ECE providers being actively involved in PA with children. This may coincide with work METs being the greatest contributor to total METs. Adult participation in PA demonstrates health behaviors to children and can encourage them to become actively engaged to find activities they enjoy. Exposure to different types of movement in early childhood may make the most impact on PA levels later in life.[17,18,25,26,43] Associations were observed between overall PA levels and several different NAP SACC sections related to PA policies and practices after adjusting for geographic locations. This could suggest that other factors may affect reports of meeting these best practices within the different locations included in this study. Further investigation in the longitudinal study may have the potential to identify confounding variables not identified in this study.

Interventions in ECE college curriculum for prospective providers should incorporate more comprehensive health behavior education. This may provide educators with the confidence to teach and participate in healthy lifestyle behaviors. Prospective ECE teachers who took courses in physical activity/education had greater self-efficacy in promoting PA with their students.[17,43]

Early childhood PA habits tend to follow through to adulthood[25] and it is the educators responsibility to provide meaningful and age-appropriate PA opportunities for a child's development, both indoors and outdoors.[22] Interventions centered around increasing PA in ECE children versus other interventions, such as reducing calorie consumption, were likely to have the most beneficial impact on health and reduce the risk of harmful health behaviors, like disordered eating habits.[26]

The influence of educators on children's health behaviors has not been widely studied. Studies analyzing provider and center-related variables have yielded inconsistent findings.[3] Furthermore, previous studies have not explored any relationships between provider's own behaviors on children's physical activity levels. Previous studies have found self-assessment with pre-intervention NAP SACC followed by ECE provider-focused interventions, exhibited improvements in post-intervention NAP SACC best

practice scores.[37] We have provided some insights into areas of ECE PA policies and practices that may need improvements, such as increasing outdoor play time.

Mental Health Status and Physical Activity

Linnan et al. reported that, compared to the national rate of depression (8%), women working in ECE centers were more likely (24-36%) to self-report symptoms that met or exceeded criteria for clinical depression on the CESD, under the criteria of scoring >16. Our study found about 40% of ECE providers met these criteria, exceeding the high end of the range of proportions reported in previous studies. The average U.S. score on the PSS was about 15 ± 7.28,[44] indicating low stress levels. We found this sample of ECE providers to have moderately high average stress levels 23.58 ± 7.73, higher than the average person in the U.S.

Previous studies investigating the effect of PA on mental health status most often assess the changes seen in those with pre-existing mental health concerns.[16,45] Our study was unable to make any comparisons for those who expressed depressive symptoms and high perceived stress at baseline. We did find, however, that leisure-time PA was one of the lowest contributors to overall weekly PA and work-related PA was the highest. Previous studies have found leisure-time PAs have positive benefits for symptoms of depression and anxiety, and high physical demands at work to contribute to high amounts of stress and poorer mental health status.[8–11,14] Our findings appear to be consistent with the findings of previous studies. This study also suggests that age may contribute some effect on mental health status and PA levels, as results reached significance on both CESD-R and PSS after controlling for possible confounding. Previous studies have found associations between age and different health lifestyle behaviors.[13] Further research is needed to more clearly understand the influence age may have on the relationship between PA levels and mental health status.

Follow-up studies may be interested in comparing any changes in mental health status if PA levels have shown to increase or decrease from baseline, especially with respect to PA domains (leisure, work, transport, domestic) and further explore possible confounding variable.

Limitations

A primary limitation of this study is the reliance on self-reported data, which is subject to recall, response, selection, and social-desirability biases. These factors, as well as limited geographic locations involved in the study, limit generalizability of any findings to the general population of ECE providers and centers. Though adjustments were made to limit confounding, we cannot be certain if unmeasured variables may have influenced the findings in this study.

Additionally, the cross-sectional design of the study can only provide associations and no causal relationship can be attributed to significant findings. This holds true for associations made between NAP SACC scores with provider PA levels, as scores were matched with provider based on center director reports on the NAP SACC. However, this study provides insight for further investigation of future studies and comparison to follow-up data in this sample population.

Conclusions

This study aimed to describe PA levels in ECE providers and how provider's PA levels relate to the PA policies and practices within ECE centers. We found ECE providers with high PA levels were associated with ECE centers who report following best practices related to outdoor play time than ECE providers with low PA levels. In addition, we found an inverse relationship between provider's PA levels and their depressive symptoms and perceived stress. Taken together, our findings suggest that ECE providers may benefit from interventions that promote their own PA for their own well-being and for any potential positive implications for the children in their care. Doing so may increase confidence in providers to meet recommendations for physical activity, as well as promote such behaviors in children at a young age.

Future Implications

The Exploring the Effects of Wage on the Culture of Health in Early Childhood Education Centers is investigating the effects of wage changes on the health of ECE providers in this sample population. Future studies should compare differences in physical activity levels, adherence to or changes

in scoring compared to best practices as outlined in the NAP SACC self-assessment, and any effects that wage changes may have on the measures analyzed in this study.

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APPENDIX

Table A. Examples of Physical Activities by Intensity and METs

Low-intensity <3 METs	**Moderate-intensity** 3-6 METs	**Vigorous-intensity** >6 METs
• Leisurely walking • Light cleaning (washing dishes, cooking) • Sitting, using computer or fishing • Playing a musical instrument	• Brisk walking (>3 mph) • Cleaning (vacuuming, washing windows, scrubbing bathtub) • Bicycling (10-12 mph) • Badminton	• Jogging/running (≥6 mph) • Hiking • Heavy manual labor (shoveling, lifting heavy loads, etc) • Bicycling (14+ mph) • Playing sports – Basketball, soccer, tennis

Adapted from Harvard School of Public Health and U.S. Department of Health and Health Services