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Original Research

Parental self-efficacy: Development of a measure to prevent children's environmental contaminant exposure

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ABSTRACT

Background: Indoor environmental contaminants (ECs) are prevalent and have dire consequences to children's development, especially for children under six. To optimize the efficacy of programs aiming to prevent exposure to ECs, it is necessary to investigate parental factors that influence behavioral change. This study presents a measure developed to assess parental self-efficacy (PSE) for preventing children from being exposed to ECs, the PSE for Contaminant Exposure Prevention (PSE-CEP). **Methods:** The PSE-CEP was administered to parents of children under six drawn from a low-income preschool ($n = 210$) and an on-line polling website ($n = 377$). An exploratory factor analysis was conducted, convergent and discriminant validity were assessed, and the relation of the measure to demographic and parenting characteristics were examined. **Results:** Based on model fit indices, a four-factor model was the best fit. Factors represented confidence in prevention using cleaning, medical care, children's physical environment, and meal time. All factors of the PSE-CEP demonstrated good reliability and construct validity and were related to more optimal parenting characteristics. **Conclusion:** A measure of this type will allow interventions to be tailored based on parents' self-efficacy to more appropriately support them in taking steps to create healthier environments for their children.

KEY WORDS: Child development, environmental contaminant exposure, exploratory factor analysis, parental self-efficacy, prevention

INTRODUCTION

Many childhood health and developmental concerns may be explained in part by children's physical environments through their exposure to environmental contaminants (ECs: e.g., lead, mercury, and radon) [1]. Treatments for the adverse effects associated with contaminant exposure, however, are largely unknown, making primary prevention the most effective strategy for protecting children [2]. Often, this line of research focuses on raising parents' awareness to the environmental health issue through education but neglects social and cognitive barriers in some parents that could negate the benefits of an effective prevention program [1].

Within the context of social-cognitive theories, various limiting factors, such as low self-efficacy, could be the barriers for parents to create health behavior change (HBC) for their children [3]. These models could provide the conceptual framework for prevention efforts to help parents improve children's home environment and reduce EC exposure by focusing on such model components like self-efficacy. Bandura (1997) defined self-efficacy as a cognitive component of people's beliefs in their own ability to engage successfully in behavioral change [4]. An application of HBC models to parents would suppose that when self-efficacy is higher, behavioral change for their children is more likely, but some parents may not have the necessary level of self-efficacy to engage in HBC.

In this manner, the parental self-efficacy (PSE) is a cognitive construct related to child and family functioning, which can be broadly defined as the expectation caregivers hold about their ability to parent successfully and influence their children's behavior and development [5,6]. Self-efficacy is generally considered task-specific, so an individual may feel effective in one domain, but not another. In considering self-efficacy for parents, they may feel confident in one aspect of parenting but less confident in another. In general, parents with higher self-efficacy are more likely to perceive problems as challenges instead of barriers and exhibit less emotional arousal and more perseverance during these situations. The construct of PSE has been positively related to warmth and negatively related to controlling parenting styles [5,7] and has been found to be a predictor of parenting behaviors in intervention programs [8]. In one of the few studies to investigate the role of caregiver

self-efficacy in the abatement of one EC (i.e., lead exposure), PSE was found to be strongly associated with preventive behaviors [9].

The development of a measure of self-efficacy assessing parents' beliefs about their ability to construct a home environment that minimizes contaminant exposure for their children would be appropriate for applying models of HBC to parental education in the context of EC prevention. This study had three objectives in developing one such measure, the PSE for Contaminant Exposure Prevention (PSE-CEP): (1) To examine the factor structure of the measure using an exploratory factor analysis (EFA); (2) to assess the measure's validity against measures of self-efficacy, self-esteem, and stress; (3) to investigate the differences between participants' self-efficacy and demographic and parenting characteristics.

METHODS

The study included low-income families with children between 3 and 5 years attending a government-funded preschool in a southeastern region of America (head start sample) and parents polled across the United States through an online survey system who had children <6 years (MTurk sample). Data from the two samples were combined to increase the sample size and make the results more generalizable to families in America.

Participants

Participants for the head start sample ($n = 210$) included parents of children enrolled in the Head Start program who were recruited during an annual health screening event in summer, 2013. The MTurk sample ($n = 377$) was recruited online through Amazon's Mechanical Turk (MTurk) in summer, 2014. Table 1 presents demographic characteristics. All questions completed with the Head Start sample were replicated with the MTurk sample and included demographic information (age, sex, ethnicity, marital status, and education) and the PC-CEP. For the MTurk sample, variables that could provide information on the validity of the PSE-CEP and explore the role of parenting in EC prevention were added [Table 2 for internal consistency, mean score, and standard deviation for measures used in the current sample].

Procedure

Participants from both samples completed the survey using the online survey system, Qualtrics. Headstart parents were asked to consent to complete a survey about contaminant exposure

Table 1: Summary of demographic information for sample

Demographic categories	Sample demographics			PS-CEP average		
	Head start (n=185)	MTurk (n=370) %	Combined (n=555) %	Head start	MTurk	Combined
Gender (n=553)						
Female	85.4 (158)	46.7 (172)	9.7 (330)	91.2 (9.3)	85.2 (13.1)	88.1 (11.8)
Male	14.6 (27)	53.3 (196)	40.3 (223)	89.3 (11.9)	80.9 (14.5)	81.9 (14.5)
Kruskal–Wallis gender comparison				χ^2 (1)=0.63, P>0.05	χ^2 (1)=8.8, P=0.003	χ^2 (1)=29.2, P=0.001
Ethnicity (n=521)						
Caucasian	44.1 (75)	59.8 (210)	54.7 (285)	90.7 (9.9)	84.1 (12.9)	85.8 (12.5)
African American	38.8 (66)	7.1 (25)	17.5 (91)	90.1 (10.4)	85.1 (16.2)	88.8 (12.3)[a]
Hispanic American	12.4 (21)	6.6 (23)	8.0 (44)	92.7 (8.1)	82.8 (15.7)	87.7 (13.3)[b]
Asian/Pacific islander	1.2 (2)	23.4 (82)	15.2 (84)	92.6(.42)	81.0 (15.2)	81.3 (15.1)[ab]
Combined races	3.5 (6)	3.1 (11)	3.1 (17)	97.6 (2.8)	82.3 (11.7)	87.7 (12.0)
Kruska–Wallis ethnicity comparison				χ^2 (4)=5.2, P=0.27	χ^2 (4)=4.7, P=0.37	χ^2 (4)=19.3, P=0.001
Education (n=552)						
< High school	7.1 (13)	1.9 (7)	3.6 (20)	94.9 (5.7)	62.9 (15.4)[abc]	84.3 (18.2)
High school or GED	51.1 (94)	7.9 (29)	22.3 (123)	89.7 (10.6)	85.0 (14.9)[a]	88.7 (11.8)[a]
Some higher education	31.5 (58)	28.0 (103)	29.2 (161)	91.5 (9.3)	83.1 (13.6)[b]	86.2 (12.8)
college degree	10.3 (19)	62.2 (229)	44.9 (248)	90.9 (9.8)	83.1 (13.7)[c]	83.9 (12.5)[a]
Kruskal–Wallis education comparison				χ^2 (3)=3.2, P=0.37	χ^2 (3)=11.0, P=0.01	χ^2 (3)=13.6, P=0.004
Marital status (n=552)						
Married	36.4 (67)	67.1 (247)	56.9 (314)	92.0 (8.3)	82.9 (13.1)	85.0 (12.7)[a]
Living with partner	7.6 (14)	13.3 (49)	11.4 (63)	93.6 (6.6)	86.5 (12.8)[a]	88.1 (12.0)[b]
With partner	1.1 (2)	6.8 (25)	4.9 (27)	95.5 (2.1)	76.1 (17.3)[a]	77.5 (17.4)[bc]
Single, separated, widowed, divorced	54.9 (101)	12.8 (47)	26.8 (148)	89.7 (10.9)	82.6 (17.1)	87.5 (13.4)[ac]
Kruskal–Wallis marital status comparison				χ^2 (3)=1.7, P>0.05	χ^2 (3)=8.3, P=0.04	χ^2 (3)=16.4, P=0.001
	M (SD)	M (SD)	M (SD)			
Age (n=548)	30.7 (9.3)	30.5 (6.3)	30.6 (7.4)			
Correlation				r=−0.07; P>0.05	r=0.02; P>0.05	r=−0.004; P>0.05

If omnibus test was significant superscripted letters provide pairwise comparisons. Demographics are presented for the sample that had sufficient information to be included in the EFA; 32 participants were excluded from the head start sample due to incomplete surveys or mistakes in survey administration. Of those who had sufficient data to be included in the EFA, some elected not to answer certain demographic questions, resulting in slight variations in sample size across demographic groups. SD: Standard deviation

Table 2: Correlations between measure, factors, validation measures and parenting

Demographic categories	Total PSE-CEP score	Factor 1	Factor 2	Factor 3	Factor 4
Combined sample (n=555)					
Factor 1, cleaning (mean=85.53; SD=15.61; α=0.89)	0.901**	1			
Factor 2, doctor visits (mean=89.43; SD=14.35; α=0.85)	0.824**	0.667**	1		
Factor 3, physical environment (mean=81.74; SD=17.68; α=0.78)	0.817**	0.631**	0.518**	1	
Factor 4, meal time (mean=86.06; SD=14.29; α=0.82)	0.874**	0.735**	0.694**	0.611**	1
MTurk sample (n=377)					
Construct validity measures					
Lead knowledge (mean=8.98; SD=2.54; α=0.78)	0.178**	0.164**	0.189*	0.128*	0.140**
Perceived stress (mean=17.45; SD=5.56; α=0.77)	−0.318**	−0.314**	−0.258**	−0.300**	−0.291**
General self-efficacy (mean=32.86; SD=5.12; α=0.92)	0.449**	0.402**	0.359**	0.375**	0.431**
Self-esteem (mean=20.78; SD=6.08; α=0.89)	0.384**	0.358**	0.356**	0.338**	0.334**
Parenting measures					
Parenting distress (mean=42.09; SD=10.09; α=0.90)	0.319**	0.300**	0.226**	0.303**	0.267**
Parent/child dysfunction (mean=48.12; SD=10.02; α=0.94)	0.415**	0.366**	0.464**	0.263**	0.374**
Authoritative (mean=84.04; SD=12.60; α=0.93)	0.476**	0.395**	0.455**	0.328**	0.420**
Authoritarian (mean=41.17; SD=17.49; α=0.90)	−0.335**	−0.277**	−0.376**	−0.153**	−0.299**
Permissive (mean=17.00; SD=6.24; α=0.80)	−0.333**	−0.0280**	−0.295**	−0.201**	−0.336**

*P<0.05, **P<0.01. SD: Standard deviation

prevention. If the parents were willing, then a researcher would obtain consent and help them complete the questionnaire using a tablet. Parents were compensated for their time with a children's book. The MTurk parents were recruited online through Amazon.com. Participants read a brief description of the study and eligibility requirements; eligibility included participants living in the United States who were older than 18 years, were biological parents of children under 6 years, and were able to complete the survey in English. If participants chose to accept, parents were linked to the survey which began with the consent form. Each was paid $1.50 to adequately compensate the participants for approximately 30 min of their time.

Measures

PSE-CEP

The PSE-CEP describes task specific parenting self-efficacy related to creating a contaminant free environment. During the development, 32 questions were created based on the behavior recommendations of government health agencies and the literature on cleaning, prevention related to nutrition, child health and wellness, and contaminant awareness [9-12]. The PSE-CEP was scored on a scale from 0 to 100 to encourage variability and the factors, and the overall measure and subscales were averaged.

New general self-efficacy scale (NGSES)

The NGSES is an 8 item measure of an internal stable attribution of success [13]. The reliability and validity of the measure are good. Participants answered each item from "strongly disagree" (1) to "strongly agree" (5) with higher scores indicative of greater general self-efficacy.

Rosenberg self-esteem scale (RSES)

The RSES is a 10-item measure with items scored on a 4-point scale ranging from strongly agree (3) to strongly disagree (0) [14]. Items worded in a negative fashion were reverse scored, so the sum of the 10-item was indicative of higher scores representing greater self-esteem. The RSES has acceptable concurrent validity [15], and the sample average was within the normal range for self-esteem (15-25).

Perceived stress scale (PSS)

The PSS is a 14-item questionnaire that examines the degree to which situations in one's life are perceived as stressful [16]. Items were designed to measure how unpredictable and overloaded respondents feel in the span of a month ranging from never (0) to always (3). Four items are reverse scored, and all items were summed so higher scores represented a greater perception of stress. A perceived stress score of 13 is considered an average level of stress; in high-stress groups, the average can be closer to 20 [16].

Parenting style and dimensions questionnaire

Parenting style was based on a questionnaire designed to measure three parenting styles [17]. Participants were asked to answer questions ranging from never (0) to always (7) that were indicative of authoritative, authoritarian, and permissive parenting. Subscales were sum-scored with higher scores indicating the parent subscribes more to a parenting style. The test-retest consistency and internal consistency of the original scale was found to be acceptable [18], but the abbreviated version used demonstrated better internal consistency.

Parenting stress index (PSI)

Two parenting-focused subscales from the PSI were included to assess the constructs of dysfunctional parent-child interaction and parental distress [19]. Item responses are on a 5-point scale ranging from strongly agree to strongly disagree. Higher scores represent a lower degree of stress. The full scale has demonstrated both high test-retest reliability and internal reliability.

Chicago lead knowledge test

The Chicago Lead Knowledge Test evaluates parental knowledge regarding lead exposure prevention [10]. The measure includes questions related to general information about lead, lead exposure, and prevention practices. Participants are asked to rate the statement as true, false, or "I don't know." Incorrect answers and "I don't know" received a score of 0; correct answers were scored as 1. Answers were sum-scored with higher scores indicative of greater lead knowledge.

RESULTS

Objective One: EFA of Measure

Of the combined sample from head start and MTurk ($n = 587$), 555 participants had complete data on the PSE-CEP and were included in the objective one analysis; 32 participants from the Head Start sample had to be removed due to mistakes in the survey that compromised the validity of their responses. This total ensures a large enough sample size to conduct an EFA because there are more than 10 observations per item [20]. Because all items were negatively skewed and had non-normal distributions, the natural log of each item was used. Due to theoretical justification, eigenvalues, and the scree plot, factor structures of three and four factors were compared. A maximum likelihood estimation and oblique oblimin rotation were completed using Mplus 5 for objective one [21].

Two iterations of model comparisons were implemented to result in 18 items [Table 3]. For item reduction, items that had poor loadings (<0.32) or cross loaded (i.e., loadings <0.45 and within 0.2 of each other) were considered for elimination. If an item was considered for elimination, and (1) was identified in the modification indices as having the potential to reduce Chi-square model fit and/or (2) did not have face validity with the factor, it was removed. The Chi-square was significant at the $P < 0.001$ value for all models, indicating that none of the models had a perfect fit; however, a ratio of the Chi-square value to degrees of freedom <3:1 is deemed acceptable provided Chi-square values are more likely suggest poor model fit for larger sample sizes. The final four-factor model for the 18 item measure achieved this ratio, had a simple structure, and good model fit from all indices [Tables 3 and 4] [20]. The first factor was comprised items related to prevention of contaminant exposure through cleaning practices and routines. The second factor, medical care, was representative of items that demonstrated adherence to medical advice and maintaining regular pediatrician visits. The third factor, physical environment, was comprised items about home improvements and repairs. The fourth related to prevention efforts surrounding meal time such as washing hands and eating healthy foods.

Objective Two: Reliability and Validity of Final Model

The total PSE-CEP and all four factors demonstrated good internal consistency using SPSS for objective two [Table 2] [20]. Construct validity was examined by evaluating Pearson product-moment correlation coefficients between the PSE-CEP total score and subscales and the total score and subscales of measures theoretically related to constructs previously linked to self-efficacy and HBC. All measures were significantly related to the PSE-CEP total score and subscales in the expected direction and magnitude: Higher lead knowledge has a weak but significant positive relationship; participants with lower stress and higher self-esteem had a moderate, significant correlation with the PSE-CEP; general self-efficacy correlated with the greatest magnitude.

Objective Three: Differentiation of Participants by Demographic and Parenting Characteristics

The head start sample scored significantly higher (t [558] = 7.1, $P < 0.001$) on the PSE-CEP (mean = 90.9, SD = 9.7) than the MTurk sample (mean = 82.9, SD = 14.0). On the full sample, there was no significant relation between the PSE-CEP and age, but significant differences were found for gender, ethnicity, education, and marital status using Kruskal–Wallis test due to the unequal group variances [Table 1] [20]. The pattern of demographic variables' relation to self-efficacy differed when examining the head start and MTurk samples separately; the gender, education, and marital status differences only remained in the MTurk sample, and there was no longer differences in ethnicity for either sample when they were separated. All analyses for investigating objective, three were conducted using SPSS 22 [22]. The total PSE-CEP score and subscales were related to lower parenting distress, less parent-child dysfunction, more authoritative parenting characteristics, and less authoritarian and permissive characteristics among the MTurk sample [Table 2].

DISCUSSION

Efforts to reduce children's EC exposure have linked PSE to prevention behaviors for children's health and well-being [9,23]. This relation is explained through models of HBC, in which domain-specific measures of PSE are necessary for determining the value and impact of an intervention so that prevention models can be successfully tested [5]. This study was successful in filling a gap in the literature by establishing a measure of PSE-CEP.

Besides excellent model fit and good factor structure, the measure had good validity. It would be expected that a domain-specific model of self-efficacy would be moderately correlated with general self-efficacy but have a relation with self-esteem and stress of a lesser magnitude [4,5,13] The PSE-CEP correlation with lead knowledge, one specific EC, is in line with Bandura's supposition that self-efficacy would increase with knowledge [4].

The PSE-CEP and its factors demonstrated further validity as they were positively correlated with parental reports of authoritative parenting and negatively correlated with permissive and authoritarian parenting. This is a consistent relation found with other measures of parenting self-efficacy and parenting characteristics of warmth, negativity, and control [5,7]. The moderate positive correlation between the total PSE-CEP score

Table 3: Exploratory factor analysis: Fit indices and simple structure for measure

Number of factors	Chi square (df)	CFI	TLI	RMSEA (90% CI)	SRMR	Simple structure
EFA for 32 items						
3	1612.15 (403)	0.92	0.91	0.07 (0.07, 0.08)	0.03	No
4	1313.12 (374)*	0.94	0.92	0.066 (0.06, 0.07)	0.025	No
EFA for 21 items						
3	777.434 (150)*	0.933	0.906	0.085 (0.08, 0.09)	0.031	No
4	562.98 (132)*	0.954	0.927	0.07 (0.07, 0.08)	0.02	No
EFA for 18 items						
3	410.17 (102)*	0.961	0.941	0.073 (0.065, 0.080)	0.025	No
4	226.675 (87)*	0.982	0.969	0.053 (0.045, 0.061)	0.015	Yes

*$P<0.001$

Good model fit identified by: CFI/TLI >0.90; RMSEA <0.06; SRMR <0.05. EFA: Exploratory factor analysis. *$p<0.05$, **$p<0.01$

Table 4: Final factor structure for measure

How confident are you that you can…	Parents confidence to engage in contaminant exposure prevention through			
	Cleaning	Medical care	Physical environment	Meal time
Remove dirt, dust and debris from my home	0.812			
Maintain a clean home	0.625			
Maintain a low level of dust in my home	0.917			
Regularly dust my home	0.909			
Keep a regular cleaning schedule.	0.633			
Regularly take my child to wellness doctor visits		0.884		
Get a doctor to complete any test or screening		0.735		
Complete the recommended immunization schedule for my children		0.771		
Follow your physicians medical advice		0.712		
Find resources or help to make repairs to my home if I do not personally have the financial means to pay for necessary repairs			0.514	
If you found out today that you had a leaky roof: How confident are you that you could take care of scheduling and financial responsibilities needed to get it fixed within the next week			0.643	
Make (or get your landlord to make) improvements that you want			0.918	
Take action to protect my children from being exposed to toxins, like lead, mold, mercury, and radon, in locations outside of the home and school			0.41	
Find (or get your landlord to find) someone you can trust to make repairs that are needed in a timely manner			0.864	
Be sure that my children always wash hands before their meals				0.452
Find vegetables that my children will eat				0.719
Regularly get my children to eat the healthy foods				0.867
Limit the amount of food my children eat that is high in fat				0.469

and authoritative parenting would indicate that self-efficacy for preventing EC exposure is associated with parenting that encourages autonomy and independence, yet still, places fair and consistent restrictions on child behavior [24]. Permissive and authoritarian parenting has been similarly associated with lower levels of PSE. Parents with higher EC self-efficacy reported less parenting distress and parent/child dysfunction, consistent with research suggesting that mothers with higher PSE engage in practices that promote positive child adjustment.

It has been established that contextual factors may play a role in PSE and child outcomes [6,25,26]. Table 1 provides the demographic differences in the PSE-CEP for the whole sample and dividing the sample into origin of recruitment (i.e., head start vs. MTurk). In particular, parents with lower levels of education reported higher self-efficacy. Personal mastery experience is a major component of self-efficacy, which could be indicative of higher educational attainment, so this result is inconsistent with theory and research [4]. Another inconsistent relation was found between self-efficacy and marital status. In previous research on self-efficacy for preventing EC exposure (i.e., second-hand smoke), married individuals reported higher self-efficacy perhaps due to spousal support [27]. In the current study, married individuals demonstrated lower self-efficacy than those not in a relationship, but participants with a partner were lower than those single or living with a partner. Consistent with previous research, males scored lower on the PSE-CEP. While the role of paternal self-efficacy is understudied compared with maternal self-efficacy, fathers have reported lower self-efficacy in domain-specific areas [28,29]. These inconsistencies in the full sample may be due to the combination of two samples that were intrinsically different. For example, the MTurk sample was older, had more Caucasians and Asian/Pacific Islanders, were more educated, and more likely to be married; head start participants had a greater chance of not having a college degree, being African American or Hispanic, and single.

The differentiation of participants based on demographic characteristics provides evidence that some parents may be

more likely to need additional support due to low self-efficacy for EC exposure prevention, but also places emphasis on future research considering how demographic groups may have different contextual factors influencing self-efficacy. For example, a study examining self-efficacy in Latino Head Start parents found the importance of a Latino identity was related to self-efficacy [30]. The authors concluded that seemingly homogeneous demographic groups are often heterogeneous in nature. In this study, parents who had obtained a high school degree in the head start sample had the highest self-efficacy, while those who only had an HS degree in the MTurk sample had substantially lower self-efficacy; it is likely parents with this level of education that migrate towards these different programs (i.e. head start vs. MTurk) have contextual factors that further differentiate them. For example, the head starts participants' higher levels of self-efficacy could be arbitrarily inflated due to a lack of prior experience or understanding of environmental neurotoxins, resulting in a poor estimation of the difficulty associated with exposure prevention [31]. These contextual factors may act as a moderating influence for intervention efficacy, affecting the strength of the program, and the mechanism behind these relations should be further investigated in light of the inconsistencies demonstrated in the sample.

Limitations and Future Directions

Previously, measures of parenting self-efficacy have been criticized for not being psychometrically sound due to minimal validation and utilization of homogeneous samples [5]. The current study attempted to address these limitations of previous work but included several limitations. There was the risk of response bias as a threat to validity such as reporting more self-efficacy than was really present. In an effort to reduce response bias, an introduction to the measure normed that parents are really busy, and may not be able to accomplish certain things even with the best intentions. Moreover, while this study attempted to obtain a nationally representative, heterogeneous sample, replication is important in American and international samples to allow for a confirmatory factor analysis and to examine predictive validity.

CONCLUSION

Self-efficacy plays an important role in HBC and could potentially act to decrease environmental exposures and the associated adverse health consequences [3] However, existing primary prevention tactics have shown unreliable results in reducing or preventing the detrimental consequences of exposure [12]. The development of a psychometrically sound measure of this type allows interventions to be tailored based on parents' self-efficacy to more appropriately support them in creating healthier environments for their children. To contribute to the strategic, focused research on the links between housing and health, and cost-effective methods to address hazards, the current study has worked to expand research questions and improve prevention initiatives.

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