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Abstract
Rural, low-income mothers face higher risk for poor health literacy and depression compared to the general population. While the association between health literacy and depression has been documented, the underlying mechanism of this relationship is not clear. Focusing on 304 low-income mothers in rural communities, this study examined the role of family context—alliance between parents and prevalence of healthful eating and physical activity in the home—in this association. Hierarchical regression followed by mediation analyses were conducted onmother's depressive symptoms controlling for mothers' demographic characteristics and access to healthcare. Lower health literacy was significantly associated with higher risk for depressive symptoms with parenting alliance partially mediating the relationship between health literacy and depressive symptoms. The finding suggests that alliance between parents is a critical aspect of mothers' social support system that may offset the negative impacts of poor health literacy on their mental health. Possible discrepancies between mothers' knowledge and their actual behaviors as well as mothers' awareness of low health literacy and their sense of need for assistance are presented along with implications for healthcare professionals and socialworkers.

Keywords: Health Literacy, Maternal Depression, Family Context, Rural PovertyRelationship between Rural, Low-Income Mothers' Health Literacy and Depressive Symptoms in the Family Context

1. BACKGROUND

Depression is one of the most prevalent psychiatric disorders experienced by adults in the United States. More than one in 15 adults (16.1 million) have experienced at least one major depressive episode in the past year (National Institute of Mental Health, 2016). The prevalence of depression is significantly higher among particular demographic groups: women are twice as likely to have depression as men (Nolen-Hoeksema, 2001); African Americans tend to report more chronic, persistent depression than White Americans (Lorant et al., 2003); and individuals in poverty are three times more likely to experience depression than those who are not in poverty (Pratt &Brody, 2008). Depression is associated with increased risk for mortality from suicide and heart disease and with higher risk for other mental disorders (e.g., anxiety disorders, eating disorders) and behavioral problems (e.g., smoking, substance abuse) (Centers for Disease Control (CDC), 2016). Depression also has negative effects on families and communities, and the negative consequences of parental depression, in particular, can bemulti-generational.

Evidence suggests that the major depression of a parent decreases parenting quality and increases the risk of children's physical, mental, behavioral, and social problems, which may extend into their adulthood (Beck, 2007; England & Sim, 2009). The economic costs of depression— decreased work productivity, medical expenses, and suicide related costs—was estimated to be$210.5 billion in 2010 (Greenberg, Fournier, Sisitsky, Pike, & Kessler, 2015).

While previous research has identified predictors and contributors to risk of depression including physical health status, chronic stress, negative thinking, and low self-esteem (Hatcher, Rayens, Peden, & Hall, 2008), recent research increasingly points to the important role of health literacy to risk of depression (Bennett et al, 2007; Coffman & Norton, 2010; Lincoln et al.,2006). Health literacy is defined as "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions" (Institute of Medicine, 2004). According to the National Center for Education Statistics (NCES) (2006), poor health literacy is more prevalent among the elderly, men, racial/ethnic minorities, immigrants, poor, and uninsured individuals and is significantly related to poor health outcomes (for a review, see Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011) including depression (Bennett et al, 2007; Coffman & Norton, 2010; Lincoln et al., 2006). Ironically, those with lower health literacy are less likely to get health information and seek treatment (NCES, 2006). Minorities and low-income individuals are primary groups who are at greater risk for both lower level of health literacy and depression.

Although the association between health literacy and depression has been documented, the mechanism of this relationship remains unclear. A few recent studies reported that low social support might be a critical factor underlying this association (Johnson et al., 2010; Kamimura et al., 2013; Steward et al., 2014). For example, Stewart at el. (2014) found that social support mediated the impact of health literacy on depression among low-income, smokers. Examining patients utilizing a free clinic, Kamimura et al. (2013) revealed that both social support and health literacy mediated most health outcomes including depression. Lee, Arozullah, and Cho (2004) argued that health literacy should not be considered an individual trait independent of social environment and that an individual's social support system might buffer the adverse effect of low health literacy. Similarly, the U.S. Department of Health and Human Services (2001) recognizes that social environment—family, community, and culture—influences how people understand, process, and communicate health information.

In this study, we examine the association between health literacy and depressive symptoms in one of the most important social environments—the family. We consider

parenting alliance as a critical aspect of a mother's social support and the prevalence of healthful eating and physical activity in the home. We specifically focus on low-income mothers who live in rural communities, which face unique health challenges compared to their urban counterparts.

Rural residents constitute 20% of the US population, however, only 10% of physicians practice in rural communities and there are significantly fewer specialists in rural areas than there are in urban areas. Rural residents are also less likely to be covered by employer-provided health insurance, and the percentage of Medicaid coverage in rural areas is lower than that in urban areas (Stanford Rural Health, 2010). Rural, low-income mothers are, therefore, one of the most vulnerable populations facing greater risk for low health literacy and depression. Based on a review of the literature, we hypothesized that rural, low-income mothers' poor health literacy increased their risk for depression but that the association between the two was mediated by the strength of parenting alliance and the prevalence of healthful eating and physical activity in the home environment.

2. METHODS

2.1 Sample

The sample for this study was drawn from a USDA sponsored, multi-state study titled *Rural Families Speak about Health* (RFSH). The project utilized a non-probability sampling technique referred to as *Mixed Purposive Sampling,* which combines the strengths of both purposive sampling and chain-referral sampling, to collect the data from 2010 to 2012 (Mammen & Sano, 2012). The overall sample consists of 444 rural, low-income families from 32 counties in 13 states (California, Hawaii, Illinois, Iowa, Kentucky, Massachusetts, Nebraska, NewHampshire, North Carolina, South Dakota, Tennessee, Texas, and Washington). Eligibility criteria for the RFSH study were mothers who were 18 years of age and older, who had at least one child under the age of 13 who lived with her 50% or more of the time, and who had an annual household income at or below 185 % of the Federal Poverty Level. Almost all of the participants lived in a rural county that had a 2003 Urban Influence Code (UIC) between 6 and 10 or that was the most rural county in the state. The UIC assigns a code to all US counties, county equivalents, and independent cities based on population size, urbanization, and access to larger communities, with higher numbers indicating greater rurality (ERS, 2013).

The sample size for this study (n = 304; mean age = 31.6) represents the subset of mothers in the RFSH study who completed all questions associated with the measures in this study. The majority of the mothers self-identified as non-Hispanic White (55.4%), followed by Hispanic (31.1%), and other (13.5%). Less than half (42.9%) of the mothers were married, while one-fifth were never married (19.7%) or lived with a partner (18.1%), and about one in ten were widowed or divorced (11.8%). More than a third (37.9%) of the mothers had a high school diploma or G.E.D, and less than one-third (30.8%) had participated in either some college or technical training after high school. More than a quarter (26.1%) did not have a high school diploma or G.E.D. While 42% of the mothers reported that they did not have health insurance, 87.8% reported that at least one of their family members received Medicaid.

2.2 Measures

Maternal Depressive Symptoms. The CES-D 10 (Andresen, Malmgren, Carter, &Patrick, 1994), a short form of the original 20-item Center for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977), was used to measure mothers' depressive feelings and behaviors during the past week. Items included depressed mood, feelings of guilt,worthlessnessand helplessness, psychomotor retardation, loss of appetite and sleep difficulties. The CES-D 10 scores ranged from zero to 30, with higher scores indicating more symptoms of depression.Cronbach's alpha for the CES-D scale was 0.82.

Predictors. Four sets of variables were used to predict maternal depressive symptoms: demographic characteristics and access to healthcare which were considered control variables while health literacy, and family context were main predictors. *Demographic characteristics* included age, race/ethnic background (1=Hispanic, 0=non-Hispanic),and education level(1=8th grade or less,2=some high school, 3=high school graduate, 4=G.E.D., 5=technical or vocational training after high school, 6=some college, 7=bachelor's degree, 8=some graduate school, 9=graduate degree). *Access to healthcare* was measured by three items based on whether, during the past year, a mother (1) had difficulty getting medical care (yes=1, no=0), (2) were prescribed a medication but were unable to get it (yes=1, no=0), (3) and, had a regular healthcare provider (1=yes, 0=no). *Health literacy* was measured by three items based on whether a mother (1) received health information in their preferred language, (2) had difficulty understanding health information received from healthcare professionals, (3) and needed to have someone help them understand health information. *Family context* was measured by two scales: (1) Parenting Alliance Measure (PAM) (Abidin & Konold, 1999), which assesses the strength of the child- rearing alliance between parents (α=.95) and (2) the Family Nutrition and Physical Activity (FNPA) scale (α=.65) (Ihmels, Eisenmann, & Nusser, 2009) which assesses the prevalence of healthful eating and physical activity in the home environment. The PAM has 20-items measured on a 5-point Likert scale (strongly agree to strongly disagree) with higher scores indicating stronger alliance. Parents indicate their degree of alliance through questions such as "When there is a problem with the child, we work out a good solution together" and "The other primarycaregiver and I communicate well about the child."

The FNPA includes 21 items that assess the type and frequency of food consumption, physical activity, sleep, media use, and family routines. An example question would be "How often does your family eat at least one meal together each day?" Response options vary from almost never to almost always, less than 7 hours, 7-14 hours, to more than 14 hours, as well as yes or no questions. Higher sum scores indicate greater prevalence of healthful nutrition and physical activity practices in the home environment.

2.3 DataAnalysis

After checking multicollinearity and bivariate correlations between study variables, hierarchical regression was conducted on maternal depressive symptoms by entering four different blocks: demographic characteristics, access to healthcare, health literacy, and family context. Then, mediation analyses were conducted to examine if the family context variables mediate the relationship between health literacy and depressive symptoms.

3. RESULTS

Table 1 shows the correlations between all variables in the model, along with means and standard deviations. Mother's depressive symptoms was significantly correlated to being non- Hispanic (r=-.28, p < .001). Among healthcare variables, mother's depressive symptoms were significantly positively correlated with "difficulty getting medical care" (r=.27, p < .001) and "difficulty getting prescribed medicine" (r=.24, p < .001), and marginally positively correlated with "having a regular doctor" (r=.08, p < .10). Among health literacy variables, mother's depressive symptoms was marginally correlated with "receiving health information in preferred language" (r=-.07, p < .10) and significantly correlated with "difficulty understanding health information" (r=.22, p < .001). Finally, mother's depressive symptoms was significantly negatively correlated with both family context variables—FNPA (r=-.18, p < .001), and Parental Alliance (r=-.26, p < .001).

Table 1. Correlations, Means, and Standard Deviations for Main Variables.

		1	2	3	4	5	6	7	8	9	10	11	12
1.	Maternal Depression	1.00											
2.	Age	.04	1.00										
3.	Education	.06	-.01	1.00									
4.	Hispanic	-.28***	.02	-.32***	1.00								
5.	Trouble getting medical care	.27***	.01*	.25***	-.10*	1.00							
6.	Trouble getting medicine	.24***	.12†	.11*	-.17**	.34***	1.00						
7.	Regular provider	.08†	.09†	.06	-.22***	-.06	.05	1.00					
8.	Preferred language	-.07†	-.08†	.07	-.20***	-.10*	-.03	.05	1.00				
9.	Difficulty in health Info	.22***	.09†	-.09†	.08†	.15**	.25***	.02	-.07†	1.00			
10.	Help needed	-.04	.06†	-.32***	.41***	-.05	-.07	-.12*	-.17***	.32***	1.00		
11.	Nutrition and activity	-.18***	-.06†	.15**	-.10*	.00	.05	.10*	.10*	-.02	-.17***	1.00	
12.	Parenting alliance	-.26***	-.07†	-.07	.15**	-.12**	-.18***	-.11*	-.05	-.19***	.05	.16**	1.00
M		7.90	31.61	3.80	.33	.50	.23	.71	.71	.90	1.39	54.35	89.59
SD		5.74	8.50	1.87	.47	.50	.42	.45	.45	.30	.62	5.70	12.06

Note. $^{\dagger}p<.10$, $^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$

Hierarchical regression was conducted to examine whether health literacy and family context variables accounted for a significant amount of variance in mother's depressive symptoms after controlling for the mothers' demographic characteristics and access to healthcare variables. As shown in Table 2, the first model with demographic information accounted for 8% [$F(3, 301)=8.76$, $p = .001$] and inclusion of health access variables accounted for 16% of the variance in depressive symptoms [$F(3, 298)=9.10$, $p=.001$]. In the sequential models, the addition of health literacy variables improved the model's explanatory power to 20% [$F(3, 295)=4.64$, $p=.001$], while the addition of family context variables improved the model's explanatory power to 25% [$F(2, 293)=10.07$, $p=.001$]. Specifically, being "non-Hispanic" and having "difficulty getting medical care" significantly increased mother's depressive symptoms, controlling for other variables. The results also showed that mothers' "difficulty understanding health information" significantly increased their symptoms of depression. Interestingly, mothers' reports regarding "needing help with health information" did not significantly predict their symptoms. Both higher FNPA scores (i.e., prevalence of healthful eating and physical activity in the home environment) and PAM scores significantly decreased depressive symptoms. Focusing on significant predictors, the addition of family context variables (i.e., FNPA, PAM) resulted in a slight decrease in the standardized beta for mothers' "difficulty understanding of health information." This suggests that family context variables may mediate the association between mothers' health literacy and depressivesymptoms.

To test this possibility, two mediation analyses were conducted on mothers' health literacy ("difficulty understanding health information") and depressive symptoms, with FNPAand PAM as mediators. Figures 1 and 2 present standardized coefficients and *p* values for these associations. Sobel test results suggested that whereas FNPA did not mediate the association(z'= -.08, n.s.), PAM did (z'= -2.28, $p<.05$.). However, the association between mother's healthliteracy and depressive symptoms remained significant after the inclusion of PAM, indicating that the mediation by PAM is not full but, rather, partial (Figure 2).

Specifically, mother's health literacy ("difficulty understanding health information") was directly positively associated with maternal depressive symptoms (β=.15, $p<.01$) and indirectly associated through the level of parenting alliance. Significant associations were found between mother's health literacy with parenting alliance (β=-.18 $p<.01$) and parenting alliance with maternal depressive symptoms (β=-.23 $p<.001$).

Table 2. Hierarchical Regression Analysis for Variables Predicting Depression among Low-Income Rural Mothers (N=304).

	Model 1			Model 2			Model 3			Model 4		
Variables	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Demographics												
Age	.03	.04	.04	.02	.04	.03	.01	.04	.01	.01	.04	-.01
Education	-.09	.18	-.03	-.28	.18	-.09	-.20	.18	-.07	-.14	.17	-.05
Hispanic	-3.51	.71	-.30***	-3.13	.71	-.26***	-3.59	.74	-.30***	-3.39	.72	-.28***
Access to Healthcare												
Trouble getting medical care				2.55	.67	.22***	2.18	.67	.19***	2.02	.65	.18**
Trouble getting medications				1.66	.79	.12	1.09	.80	.08	1.03	.18	.08
Regular healthcare provider				.39	.70	.03	.29	.69	.02	.36	.67	.03
Health Literacy												
Preferred language for health information							-1.78	1.03	-.09†	-1.67	1.00	-.09†
Difficulty understanding health information							2.67	.88	.18**	2.43	.87	.17**
Need help with health information							.05	.48	.01	-.12	.57	-.01
Family Context												
Parenting alliance										-.18	.05	-.17***
Nutrition and physical activity										-.06	.03	-.13*
R^2		.08			.16			.20			.25	
F for change in R^2		8.76***			9.10***			4.64***			10.07***	

Note. †$p<.10$, *$p<.05$, **$p<.01$, ***$p<.001$

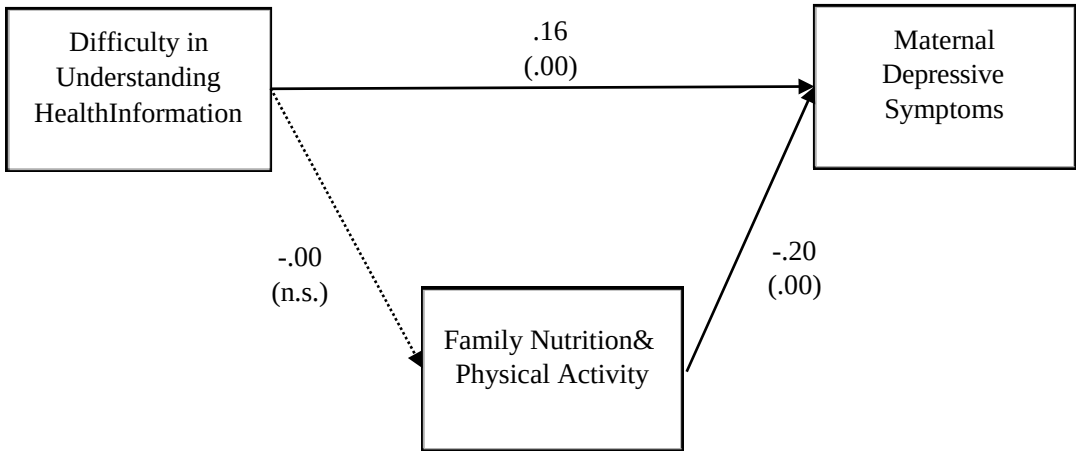

Figure 1. Standardized Coefficients (*p* values in parentheses) for the Relationship among Rural Mothers' Health Literacy, Depressive Symptoms, and Family Nutrition and Physical Activity.

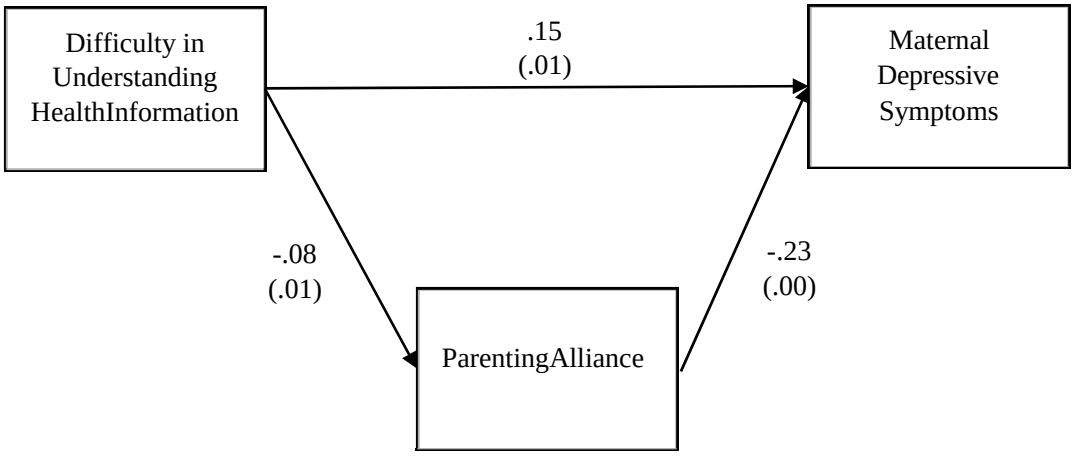

Figure 2. Standardized Coefficients (*p* values in parentheses) for the Relationship among Rural Mothers' Health Literacy, Depressive Symptoms, and Parenting Alliance.

4. DISCUSSION

The present study examined the association between low-income mothers' health literacy and depressive symptoms and the role of family context in this association. The results of this study indicated that lower health literacy was significantly associated with elevated risk for maternal depression, which is consistent with previous studies (Bennett et al, 2007; Coffman & Norton, 2010; Lincoln et al., 2006). Our other hypotheses were partly supported by the result that the relationship between mother's health literacy and depressive symptoms was partially mediated by parenting alliance but not by other family environmental factors (prevalence of healthful eating and physical activity in the home environment). Although this partial mediation of parenting alliance is consistent with previous studies showing that social support mediates the association between health literacy and depression (Johnson, Jacobson, Gazmararian, & Blake, 2010; Kamimuraet al., 2013; Steward et al., 2014), few studies have investigated the role of healthfulness of the home environment in this association. Thus, we are not able to determine if our results are consistent with the pattern for the general population or unique to our sample of rural, low-income mothers.

Parenting alliance, a form of social support, is considered one of the most important resources for low-income mothers capable of offsetting stressful life events (Ontai, Sano, Hatton, & Conger, 2008). While past research identified general social support as a mediating factor between health literacy and depression, the results of the present study suggest that parental support functions, at least partially, mediate this association for rural, low-income mothers. We speculate that mothers who have a supportive co-parent are more likely to discuss any health information they have received with their co-parent, decreasing the risk for maternal depression. Conversely, not having a supportive co-parent might exacerbate mothers' stress, particularly when they experience difficulty in understanding health information, thereby, increasing their risk for depression.

Notably, mother's health literacy and FNPA scores were not significantly correlated. One possible explanation is that there are discrepancies between mother's health knowledge and their behaviors. FNPA measures *behaviors* related to nutritional practice and physical activity level, not their *knowledge*. In previous studies focusing on the same rural, low-income mothers, we reported that mothers' knowledge did not directly translate into action due to multiple challenges faced by mothers, including daily stresses, lack of time, financial anxiety, lack of access to healthy foods and safe playground, and so on (Mammen, Sano, Braun, & Maring, 2016). Thus, further research is needed to identify the association (or lack thereof) between health literacy and mother's health-related behaviors.

Among the three items constituting health literacy, only "difficulty understanding health information" was found to be significantly related to increased maternal depressive symptoms, holding other variables constant. It was puzzling that the third item—if a mother needed to have someone help her to understand health information—did not significantly impact maternaldepression. Findings by Johnson et al. (2010) may offer an explanation for this lack of significance. Examining whether social support helps patients with medical adherence, Johnson et al. found that individuals with limited health literacy were not likely to disclose their difficulty understanding medical instructions and were highly reluctant to ask others for help unless they had a trusted confidante. Thus, the mothers who reported having difficulty understanding the health information in our sample may not have felt the *need* to ask others for help. Similar to the discrepancy between knowledge and behavior discussed in the previous section, the mothers' awareness of not understanding medical information may not directly influence their sense of needing assistance.

Finally, two of the control variables significantly increased the risk for maternal depression: being non-Hispanic and having difficulty getting medical care. Our finding shows that Hispanic mothers had a significantly lower level of depressive

symptoms, which is consistent with past research (Lorant et al., 2003). Furthermore, mothers who reported difficulty getting medical care had significantly increased risk for depression, holding other variables constant. This is particularly concerning for rural communities where public transportation may not be easily accessible, the number of physicians and mental health specialists are limited, and a stronger stigma is attached to mental illness than in urban communities. These contextual challenges unique to rural communities make it even less likely that low-income mothers, and particularly those with low health literacy, will obtain the health care services needed to prevent and treat depression.

Although the present study provides valuable insight into the mechanisms underlying the association between health literacy and depressive symptoms it has several limitations. First, our operationalization of health literacy is limited to three items. As explained earlier, the concept ofhealth literacy is multi-dimensional and encompasses the "ability to obtain, process, and understand health information" (Institute of Medicine, 2004) in order to make appropriate decisions. It includes knowledge, skills, and actions. More comprehensive measures of health literacy need to be included in future studies. Second, because the study relied on cross-sectional data, the findings do not allow inferences about causality. Longitudinal studies are needed to clarify causal relationships among health literacy, social support, and depression. Finally, although the study focused on an important yet largely ignored population—rural, low-income mothers—the sample does not reflect the full diversity of rural mothers. For example, compared to U.S. born Hispanic mothers, recent immigrant Hispanic mothers face additional challenges of adopting to a new society which can result in higher prevalence of depression (Coffman & Norton, 2010). As cultural contexts of rural, low-income mothers are diverse, the results of this study should be interpreted with caution.

Overall, however, the present study contributes to the literature by focusing on the mechanism underlying the relationship between health literacy and depressive symptoms in the family context. This is particularly important given that much of the literature on health literacy pays little attention to parental support as a critical factor for mothers with limited resources.

Given the results of previous research showing that rural, low-income mothers prioritize their children's well-being over their own (Sano, Manoogian, & Ontai, 2012) and the observation that parental support can offset many life stresses including health outcomes, health care professionals and social workers who provide services to low-income mothers should take mothers' priorities and needs into account in order to prevent and treat depression. More importantly, any information on mental health should be communicated in a manner that does not require high literacy skills. Alternative communication methods that rely more on visualmaterials than text should be considered when providing information to rural mothers. In addition, given the finding that mothers with low health literacy are often reluctant to ask for help, healthcare professionals and social workers should be cognizant of the importance of developing rapport and creating trusting relationships with low-income mothers. At the same time, rural, low-income mothers would likely benefit from opportunities to improve their health literacy and mental health.

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