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Individual, seizure-related, and psychosocial predictors of depressive symptoms among people with epilepsy over six months

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Abstract

Depression is the most frequently diagnosed psychiatric disorder among people with epilepsy. A variety of risk factors for depression among people with epilepsy have been identified, however, few studies have examined these risk factors over time. The primary purpose of this study was to explore the relationship between demographic characteristics, seizure-related factors, and psychosocial factors and depressive symptoms over 6 months. Three hundred and nineteen adults with epilepsy completed three surveys at three-month intervals. Multiple linear regression was used with the baseline variables to predict depressive symptoms at baseline, 3-months, and 6-months. Employment status, social support, and stigma emerged as predictors of depressive symptoms at all three timepoints. Other factors that predicted depression symptoms in one or two timepoints were self-management, financial strain, and activity restriction due to seizures. The results indicate that multiple factors influence depressive symptoms among people with epilepsy.

Keywords

epilepsy; depression; stigma; social support; employment

Introduction

Depression is the most frequent co-morbid psychiatric disorder among people with epilepsy [1,2]. Major depression also occurs at a higher rate among people with epilepsy compared to the general population [1,3]. People with both epilepsy and depression tend to report a negative impact on a variety of factors, including physical functioning, energy, memory, emotional well-being, and general quality of life [4–6]. Cramer and colleagues have found that even mild-to-moderate depression can affect quality of life for people with epilepsy.

In recognition of the serious impact that depression has on people with epilepsy, the organizers of the 2003 National Conference on Public Health and Epilepsy recommended improving the current “assessment and treatment of the mental health needs of people with epilepsy through

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professional education and research” [7]. In order to achieve this goal, it is crucial to understand the underlying factors that contribute to depression among people with epilepsy.

Based on our current understanding and research in the area, we know that several factors may place people with epilepsy at risk for depression. Investigators studying risk factors of depression among people with epilepsy have used cross-sectional designs to examine individual characteristics, seizure-related factors [8–15], and psychosocial variables [8,10,16].

Individual and seizure-related factors commonly associated with depression include employment status [17,18], seizure severity [17,19], seizure frequency [20], seizure type [2,21], and side-effects of antiepileptic medicine [8,17]. The health effects of epilepsy may also contribute to depressive symptoms. Adults with epilepsy report more mental, physical, and overall unhealthy days than those without epilepsy [22,23]. Also, 63.5% of people with active epilepsy report some form of disability, compared with 17.9% of the general population [24].

Epilepsy can lead to social isolation and dependency on others especially when it prevents people from driving or working [25]. In one study, over one-third of participants felt that epilepsy affected their ability to work, and 41% said that it affected their social life [26]. Second, people with epilepsy may encounter stigma because the unpredictable and uncontrollable nature of seizures can elicit fear and concern in others. Up to 50% of people with epilepsy reported experiencing stigma related to their epilepsy, and those with more frequent seizures were more likely to feel highly stigmatized [26].

In addition to studying social support and stigma, investigators have demonstrated an association between self-management behaviors and depression and between self-efficacy and depression [27–29]. Living well with epilepsy requires a variety of self-management behaviors in order to control seizures, including medication adherence, stress management, and maintenance of good sleep habits [7,30]. Studies of other chronic diseases demonstrate that people with depression are less likely to maintain self-management behaviors, including medication adherence [31–33]. Depression is also negatively associated with the self-efficacy, or confidence, one has for performing self-management behaviors [28].

Although cross-sectional designs can provide some understanding of relationships at one point in time, analyzing data collected at one time point does not give any indication of the sequence of events. A longitudinal study design, in which data are collected from the same people at successive time points, can facilitate the evaluation and understanding of relationships between risk factors and identified health outcomes. In the current study, we were interested in examining the relationships between a set of risk factors and the health outcome of depressive symptoms among people with epilepsy. We used data collected from individuals during a 6-month period. The primary purpose of this study was to explore the relationship between demographic characteristics, seizure-related factors, behavioral factors (self-management, self-efficacy, and medication adherence), and social factors (social support, stigma, and patient satisfaction) and depressive symptoms over time.

Methods

The study was a secondary analysis of data obtained from an epilepsy self-management research study called Project EASE (Epilepsy Awareness, Support, and Education). Project EASE was a study funded by National Institute of Nursing Research and designed to study self-management practices of people living with epilepsy (see, for example, 27–30, 38). Following institutional review board approval at the researchers’ institutions and clinical sites, participants were recruited from an epilepsy clinic in Boston, Massachusetts and 2 clinics in Atlanta, Georgia (an epilepsy clinic and a general neurology clinic). All participants met the

following inclusion criteria: (1) diagnosis of epilepsy for at least 1 year, (2) in current treatment for seizures, (3) between 18–75 years of age, (4) able to read and understand English, (5) mentally competent as judged by a health care provider, and (6) willing to participate. Exclusion criteria were: (1) presence of a rapidly progressing neurological or medical disorder, (2) history of psychiatric syndrome that could limit participation, (3) exclusively nonepileptic seizures not being treated with antiepileptic drugs, (4) history of significant substance abuse within the past year, (5) participation in a study of porcine cell transplantation being conducted at one of the clinics. People with a history of sensitivity to photic or pattern stimulation were evaluated by their physician prior to enrollment in the study. After providing written informed consent, participants completed three surveys at 3-month intervals (baseline, 3-months, and 6-months). Interviews were conducted using computer-assisted interviewing technology. Participants received \$25 for each completed assessment, and those in Atlanta also received a small stipend for travel and parking expenses [28,34].

Measures

Depressive symptoms were measured using the Center for Epidemiologic Studies Depression Scale (CES-D) [35]. The 20 CES-D items assess the presence of symptoms over the past week. Each item is rated on a 4-point scale from rarely occurs (0) to occurs most or all of the time (3). The items are summed to create a total score, and higher scores correspond with more depressive symptoms. The CES-D has been assessed for both reliability and validity among a community population [35] and for reliability among people with epilepsy [36]. Cronbach's α for the items from the baseline assessment was .92; for the 3-month assessment, it was .93; for the 6-month assessment, it was .93.

Epilepsy self-management was measured using the Epilepsy Self-Management Scale (ESMS). Each of the 38 items is rated on a 5-point Likert scale from never (1) to always (5). The ESMS has five subscales—medication, information, safety, seizure, and lifestyle management. Total scores for the entire scale and the subscales are obtained by summing responses to individual items, and higher scores indicate more frequent use of self-management strategies. Reliability and validity were assessed for the original 26-item version [37,38]. Cronbach's α for the items from the baseline assessment in the present study was .78 for the total scale. The Cronbach's α for the subscales ranged from .57 to .74.

Self-efficacy was measured using the Epilepsy Self-Efficacy Scale (ESES) [37,39]. Each of the 33-items is rated on an 11-point Likert scale from I cannot do at all (0) to sure I can do (10). The items are summed to yield a total score, and higher scores represent higher levels of confidence for managing epilepsy. Reliability and validity have been previously assessed [37–40]. Cronbach's α for items from the baseline assessment in the present study was .89.

Medication adherence was measured using a version of the Self-Reported Medication-Taking Scale [41] that had been modified for antiepileptic drugs. The 9-item scale includes 8 dichotomous items (yes/no) and 1 item rated on a 5-point Likert scale (never/rarely to all the time) to address barriers to taking medication. For scoring, 7 of the 8 dichotomous items are reversed scored, with no responses coded as 0 and yes responses coded as 1, and the 9th item is scored on a scale from 1–5. Reliability and validity of the scale have been assessed for individuals with hypertension [42]. The α for this sample of people with epilepsy was .52.

Social support was assessed using the Personal Resource Questionnaire 85 Part 2 (PRQ85-2). Each of the 25 items is rated on a 7-point scale, ranging from strongly disagree (1) to strongly agree (7). Total scores are found by summing responses to individual items, and higher scores correspond to higher levels of social support. The Cronbach's α for the items from the baseline

assessment in this study (.91) is similar to reliability coefficients calculated for other samples of people with epilepsy (.88 and .90) [28,37,38,43].

Stigma was measured using the Epilepsy Stigma Scale, which was modified from the Parent Stigma Scale [44]. This scale assesses the degree to which a person believes that epilepsy is perceived as negative and interferes with relationships with others. The 10 items are rated on a 7-point scale from strongly disagree (1) to strongly agree (7). Item responses are summed to yield a total score, and higher scores are associated with greater perception of stigma. This scale has been assessed for reliability and validity [45]. The Cronbach's alpha for the items from the baseline assessment for the present study was .91.

Patient satisfaction was measured with the 50-item Patient Satisfaction Questionnaire [46]. The items are rated on a 5-point scale from strongly disagree (1) to strongly agree (5). The scale contains seven subscales: general satisfaction, interpersonal aspects, communication, technical aspects, time spent with doctor, financial aspects, accessibility, and convenience. Total scores are found by summing responses to individual items, and higher scores reflect more positive outcomes. Reliability and validity of this scale have been tested among individuals diagnosed with at least one of four chronic diseases: hypertension, diabetes, heart disease, or depression [46]. The Cronbach's α calculated for the overall scale for the items from the baseline assessment in this study was .94. The reliability coefficients for the subscales ranged from .69 to .87.

Additional self-report information was collected on demographic and epilepsy-related characteristics. Demographic information included age, gender, marital status, education, income, living situation, and employment status. Epilepsy-related variables were age at first seizure, seizure type, seizure severity, and activity restriction due to seizure condition.

Statistical Analysis

Data were analyzed with SPSS Version 16.0. Descriptive statistics were used to characterize the sample. One-way analysis of variance (ANOVA) and Pearson correlation coefficients were conducted to assess differences and associations among individual, seizure-related, and psychosocial variables measured at baseline and total CES-D score assessed at baseline, 3-month, and 6-month. A series of stepwise multiple regression models was fitted with the demographic, seizure-related, and psychosocial variable measured at baseline. Three separate models were created. In the first model, all variables were assessed at baseline. In the second model depression measured at the 3-month assessment was regressed on the variables measured at baseline. Likewise in the third model, depression measured at the 6-month assessment was regressed on the baseline predictor variables. In each model, the demographic variables were entered first, followed by the seizure-related variables, and finally the psychosocial variables. Only those psychosocial variables that demonstrated a significant association with depressive symptoms in the bivariate analyses were entered into the models. The three models were run twice. In the first set, the total scale score for ESMS and Patient Satisfaction were used. In the second set of analyses, each of the subscale scores for these two scales were used.

Results

Three hundred and nineteen participants completed the CES-D at baseline. Participant demographic and seizure characteristics are presented in Table 1. The participants had a mean age of 43.2 years, and there were about equal percentages of males and females. The majority of participants were white (80.6%), did not work (51.4%), and had an income greater than \$30,000 (57.9%). The mean age that seizures began was 22 years, and over three quarters of the participants experienced a seizure in the past year.

The mean baseline CES-D score was 15.76. Mean depression scores for 3-month and 6-month assessments were 15.94 and 14.59, respectively. There was no significant change in mean depression scores over the 3 timepoints. At baseline, 40.1% of the participants experienced elevated depressive symptoms, as indicated by a score of 16 or above on the CES-D. The percentages of people with elevated depressive symptoms at 3- and 6-months were 40.7% and 39.4%, respectively. At baseline, depressive symptoms did not differ across age, gender, race, or living situation (see Table 1). Baseline depressive symptoms were significantly higher among people who were separated, divorced, or widowed compared to married, people who had a high school degree or less compared to college graduates, people who were not working, and people with an income of less than \$30,000 per year. For seizure-related variables, higher CES-D scores were correlated with greater seizure severity and activity restriction due to seizure, but not with age at first seizure.

Tests of association between the baseline psychosocial variables and CES-D scores for all three time periods (Table 2) showed that higher levels of stigma and lower levels of medication adherence were associated with higher CES-D scores, as were lower levels of self-management, self-efficacy, social support, and overall patient satisfaction. Three of the self-management subscales—medication, information, and lifestyle—were significantly associated with depression for at least one timepoint. All seven of the patient satisfaction subscales showed negative associations, though both the general satisfaction and time spent with doctor subscales were not significantly associated with depression at 3-months.

Table 3 provides the results of the multiple linear regression models, where depression at baseline, 3-month, and 6-month assessments was predicted by baseline variables. Each of the models was run twice, first with the overall summary scores for the ESMS and Patient Satisfaction and then with the subscale scores for each of the two scales. Compared to the models with the summary scores, the models that included the subscale scores for ESMS and Patient Satisfaction explained more of the variance in depression scores, and are thus presented here.

In the first model that included only variables measured at baseline, 46.2% of the variance in depression was explained by the predictor variables. The significant relationships with depression were income, employment status, activity restriction, lifestyle self-management, self-efficacy, social support, stigma, and patient satisfaction related to financial aspects. Lower income (<\$30,000), not working, activity restriction due to seizures, and stigma were associated with higher depression scores. Lifestyle self-management, self-efficacy, social support, and financial aspects of patient satisfaction were negatively associated with depression scores.

In the second model in which depression scores at 3-months were regressed on the baseline variables, 28.7% of the variance was explained. The significant variables included employment status, activity restriction, medication self-management, social support, and stigma. Not working, activity restriction, and stigma were positively associated with depression, while medication self-management and social support showed negative associations with depression scores.

The third model, in which 6-month depression scores were regressed on baseline variables, 33.2% of variance of the variance in depression was explained. Significant relationships with depression included employment status, living situation, medication self-management, social support, and stigma. Not working, living with people who were not family, and stigma were associated with higher depressive scores. Higher scores on medication self-management, social support, and stigma corresponded to lower depression scores.

Three variables remained significant in all three models: employment status, social support, and stigma. All of the models also included a subscale of self-management, either lifestyle or medication, as a predictor. Finally, two variables related to financial strain—income and financial aspects of patient satisfaction—were predictors in at least one of the models.

Discussion

This study is one of the first to examine the predictors of depressive symptoms among people with epilepsy over time. The results indicate that individual, seizure, and psychosocial factors can contribute to depressive symptoms. The three major factors that predicted depressive symptoms at each timepoint were employment status, social support, and stigma. Other factors that were important during the 6-month period were income, living situation, activity restriction, self-management, self-efficacy, and patient satisfaction.

Based on the study results, it appears that financial strain is an important contributor to elevated depressive symptoms among people with epilepsy in this sample. Three factors related to finances that were significant in at least one of the models were employment status, income, and financial aspects of patient satisfaction. Employment status emerged as one of the main factors influencing depressive symptoms at each timepoint. Participants who did not work consistently reported higher depression scores. In the first model, using baseline data, having an income below \$30,000 and lower satisfaction with the financial aspects of patient care also contributed to depressive symptoms. The financial aspects of patient satisfaction was also a significant predictor at the 6-month assessment. These findings suggest that financial strain, to which unemployment can contribute, can lead to increased symptoms of depression. This finding is consistent with several other studies of epilepsy and depression, in which investigators found that people with epilepsy and depression were less likely to be employed [8,9,17,47] and were more likely to have a lower income [8] and experience financial stress [10]. In contrast, Schmitz (2005), in a small sample, found that working status had no effect on depressive symptoms [48]. These patterns of increased rates of depression among people who are unemployed and have low income are also seen in the general population [49,50].

The results of the present study indicate that interpersonal relationships, as measured by social support and the experience of stigma, are also important contributors to depressive symptoms. Social support was found to be a main predictor of depressive symptoms in all three models, with those reporting lower levels of support also reporting higher depression scores. Because of the unpredictable nature of seizures, people with epilepsy tend to avoid social situations, often leading to social isolation [26]. Frequent or poorly controlled seizures, particularly when the seizure disorder prevents driving or full employment, can also lead to dependency on others [25]. According to Hermann and Whitman, people with epilepsy who reported having less social support and less satisfaction with available support tended to experience more symptoms of depression [10]. Social support has long been linked with depression [51] and research on other chronic diseases has indicated that lack of support from a person's social network increases the risk of depression [52,53].

The third main predictor of depressive symptoms was epilepsy-related stigma. People with epilepsy may encounter stigma because the unpredictable and uncontrollable nature of seizures can elicit fear and concern in others. Up to 50% of people with epilepsy reported experiencing stigma related to their epilepsy and those with more frequent seizures were more likely to feel highly stigmatized [26]. Stigma associated with epilepsy has been shown to impact the self-efficacy, or confidence, needed to manage the condition [28]. Only two other investigators have included stigma when analyzing risk factors of depression. Both found that people who reported experiencing prejudice because of their epilepsy or perceived epilepsy to be a stigmatizing condition also reported higher levels of depression [10,16].

Other factors, particularly self-management and activity restriction, were related to depression symptoms in at least one timepoint. In each of the models, an aspect of self-management was a significant predictor of depressive symptoms: lifestyle management at baseline and medication management at the 3 and 6-month assessments. This finding implies that self-management of epilepsy is important, not only for controlling seizures, but also for preventing depression. Lifestyle and medication management also capture important behaviors for epilepsy self-management – adhering to medication, reducing stress, and improving sleep [7, 30]. However, in this study, medication adherence was not a significant predictor of depressive symptoms. An additional consideration is that lifestyle management may have a reciprocal relationship with depression; as a person's depressive symptoms worsen they may be more likely to decrease self-management behaviors [29].

Seizure-related variables seemed to be less influential for depressive symptoms in this sample. Interestingly, activity restriction due to seizures was the only seizure-related variable that served as a predictor within the models. In the baseline and 3-month model, greater activity restriction was associated with higher depression scores. Seizure type was not associated with depressive symptoms, even at the bivariate level, which differs from other studies [9,13]. Additionally, age of first seizure was not a significant predictor of depressive symptoms. This result is similar to other studies [9,14,17,48], although in one study, age at onset and duration of epilepsy was associated with depression [11]. The Project EASE dataset did not include a measure of seizure frequency, which often is found to be associated with depression [11,12, 14,17,54].

Limitations

There are several limitations for this study. First, data for this study were obtained from a larger study on self-management behaviors; therefore we were limited to the variables included in the dataset. The data allowed for analysis of variables that had not yet been examined as predictors of depressive symptoms, but also did not include potential predictors such as seizure frequency or other covariates such as antidepressant use. Second, all data, including depressive symptoms, was collected by self-report. The CES-D was found to be a reliable measure of depression among people with epilepsy [36], though elevated scores are not the same as a clinical diagnosis of depression. However, it is still valuable to utilize self-report measures of depressive symptoms, because sub-clinical levels of depression have been shown to impact quality of life [5]. Third, the associations of depression with the predictor variables do not imply causation. Indeed, it is possible that these relationships are reciprocal. For example, Thapar, Roland, and Harold found a bidirectional relationship between depressive symptoms and seizure frequency [54]. Another recent study showed that depression, stress, and anxiety were all important in predicting seizure recency and frequency [55]. Further research is required to assess these complex relationships. Finally, the results of the study may not be representative of the entire population of people with epilepsy. The participants were recruited from two epilepsy clinics and one neurology clinic and thus may represent a population with more severe epilepsy.

Implications

The results of this study have implications for clinical practitioners and researcher. First, roughly 40% of the participants experienced elevated depressive symptoms, which underscores the need for clinicians to routinely screen for and treat depression among adults with epilepsy. Second, the results show that depressive symptoms among people with epilepsy are influenced by factors on multiple levels. While causal claims cannot be made, this study indicates that employment status, social support, and stigma can predict depressive symptoms over time. Other influential factors include income, activity restriction due to seizure condition, self-

management behaviors, and patient satisfaction related to financial aspects of care. Therefore, in addition to screening for depression, clinicians could assess patients on these risk factors and offer assistance to those who need it. Future research could examine the change in individual trajectories of depression over longer periods of time and explore the possible reciprocal relationship between depressive symptoms and the predictor variables. Another avenue of research could be how interventions to promote employment, improve social support, reduce stigma, and improve self-management impact depressive symptoms.

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Table 1
Baseline demographics, seizure characteristics, and depressive symptoms scores of Project EASE participants (n=319)

Characteristics	n (%)	Mean CES-D score (SD)	
Gender			
Female	161 (50.5)	15.53 (11.8)	
Male	158 (49.5)	16.00 (11.9)	$t=-.356$
Race/Ethnicity			
African American	50 (15.7)	17.98 (11.2)	
Caucasian	257 (80.6)	15.35 (11.7)	
Other	12 (3.8)	15.42 (16.6)	$F=1.041$
Marital Status			
Married	163 (51.1)	13.63 (11.1)	
Single	96 (30.1)	16.48 (11.5)	
Separated/Divorced/Widowed	60 (18.8)	20.42 (12.9)	$F=7.787^{**}$
Living Situation			
Alone	64 (20.1)	16.95 (12.2)	
With immediate family	204 (63.9)	14.79 (12.0)	
With others (ex. extended family, partner, roommate)	51 (16.0)	18.14 (13.2)	$F=2.046$
Education			
High school or less	70 (22.5)	18.56 (11.6)	
Some college	102 (32.9)	16.67 (11.1)	
Graduated college or post graduate	138 (44.5)	13.67 (12.3)	$F=4.484^{*}$
Employment			
Working	155 (48.6)	12.62 (9.5)	
Not working	164 (51.4)	18.73 (13.0)	$t=-4.805^{**}$
Income			
$\geq \$30,000$	128 (40.0)	12.66 (10.2)	
$< \$30,000$	184 (57.9)	20.33 (12.7)	$t=5.669^{**}$
Seizure Type			
General	136 (42.8)	16.30 (12.5)	
Partial	125 (39.0)	15.42 (11.2)	
Other	6 (1.9)	15.33 (12.8)	
Unknown	52 (16.4)	15.48 (11.6)	$F=.139$
	Range	Mean (SD)	
Age (years)	19–75	43.20 (11.7)	$r=-.055$
Age at first seizure (years)	1–73	22.29 (15.6)	$r=-.057$
Activity Restriction	1–4	2.22 (.8)	$r=.393^{**}$
Seizure Severity	0–4	1.73 (1.2)	$r=-.304^{**}$

* $p \leq .05$;

**
 $p \leq .01$

CES-D, Centers for Epidemiologic Studies Depression Scale

Table 2
Correlations between study variables and depressive symptoms

	CES-D Baseline	CES-D 3-month follow-up	CES-D 6-month follow-up
Epilepsy Self-Management – overall score	–.112 *	–.008	–.074
Epilepsy Self-Management – medication management subscale	–.258 **	–.229 **	–.279 **
Epilepsy Self-Management – information management subscale	.079	.120 *	.075
Epilepsy Self-Management – safety management subscale	.052	.098	.061
Epilepsy Self-Management – seizure management subscale	–.099	–.062	–.053
Epilepsy Self-Management – lifestyle management subscale	–.248 **	–.082	–.150 *
Epilepsy Self-Efficacy	–.472 **	–.309 **	–.320 **
Social Support	–.508 **	–.429 **	–.417 **
Stigma	.425 **	.343 **	.371 **
Medication Adherence	.257 **	.166 **	.228 **
Patient Satisfaction – overall score	–.350 **	–.271 **	–.327 **
Patient Satisfaction – general satisfaction subscale	–.152 **	–.107	–.156 *
Patient Satisfaction – interpersonal aspects subscale	–.300 **	–.266 **	–.333 **
Patient Satisfaction – communication subscale	–.241 **	–.187 **	–.277 **
Patient Satisfaction – technical aspects subscale	–.278 **	–.226 **	–.240 **
Patient Satisfaction – time spent with doctor subscale	–.162 **	–.107	–.209 **
Patient Satisfaction – financial aspects subscale	–.376 **	–.251 **	–.312 **
Patient Satisfaction – accessibility and convenience subscale	–.295 **	–.245 **	–.327 **

* $p \leq .05$;

** $p \leq .01$

CES-D, Centers for Epidemiologic Studies Depression Scale

Table 3
Multiple linear regression models with significant predictors of depressive symptoms over time

Variable	Baseline			3 Month Follow-up			6 Month Follow-up				
	B	SE	p	B	SE	p	B	SE	p		
Income ¹	2.677	1.157	.021	-	-	-	-	-	-		
Employment Status ²	2.894	1.106	.009	4.803	1.467	.001	5.099	1.427	.0001		
Living Situation ³	-	-	-	-	-	-	4.108	1.891	.031		
Activity Restriction	2.371	.695	.001	1.664	.899	.065	-	-	-		
Self-Management – Lifestyle subscale	-.368	.141	.010	-	-	-	-	-	-		
Self-Management – Medication subscale	-	-	-	-.468	.181	.010	-.403	.179	.004		
Self-efficacy	-.051	.016	.001	-	-	-	-	-	-		
Social Support	-.103	.027	.0001	-.155	.034	.0001	-.109	.032	.001		
Stigma	.101	.039	.009	.117	.050	.021	.141	.048	.004		
Patient Satisfaction – Financial Aspects subscale	-.264	.072	.0001	-	-	-	-.212	.094	.025		
			Adjusted R ² = .462			Adjusted R ² = .287			Adjusted R ² = .332		

¹ Income <\$30,000 = 1; Income ≤\$30,000 = 0

² Not working = 1; Working = 0

³ Living with those other than family = 1; Living with family = 0