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Is purpose in life associated with less sleep disturbance in older adults?

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Abstract

Background: Previous work has shown that purpose in life can be protective against numerous negative health outcomes including sleep disturbances. Given that sleep disturbances are common among older adults and African Americans, the aim of the present study was to examine the relationship between purpose in life, overall sleep quality, and the presence of sleep disorders in a community-based bi-racial sample of older adults.

Methods: Participants were 825 non-demented older African Americans ($n = 428$) and Whites ($n = 397$) from two cohort studies, the Minority Aging Research Study (MARS) and the Rush Memory and Aging Project (MAP). Participants completed a 32-item questionnaire assessing sleep quality and symptoms of Sleep Apnea, Restless Leg Syndrome (RLS) and REM Behavior Disorder (RBD). Purpose in life was assessed with a 10-item measure modified from Ryff & Keyes's scales of Psychological Well Being.

Results: In a series of hierarchical multiple linear regressions controlling for the demographic covariates of age, sex, race, and education, higher levels of purpose in life were associated with better sleep quality at baseline. Using longitudinal follow-up data, higher levels of purpose in life was associated with lower risk of sleep apnea at baseline, 1-year follow-up, and 2-year follow-up, as well as reduced symptoms of RLS at 1-year and 2-year follow-up.

Conclusions: These findings provide support for the hypothesis that a higher level of meaning and purpose in life among older adults is related to better sleep quality and appears to be protective against symptoms of sleep apnea and RLS.

Keywords: Purpose in life, Sleep quality, Sleep apnea, Restless leg syndrome, REM behavior disorder, Older adults, African Americans

Background

Disturbances in sleep are common in older adults, with an estimated 32–45% of older adults reporting some sleep complaint such as difficulty falling or staying asleep, or disrupted sleep (Ancoli-Israel 2009; Beaudreau et al. 2012; Kim et al. 2015). Also, almost 40% of older adults suffer from a sleep disorder (Kim et al. 2015; Jaussent et al. 2011), with the most common primary sleep disorders in the elderly being sleep-disordered breathing, REM behavior disorder (RBD) and restless legs syndrome (RLS) (Ancoli-Israel 2009; Foley et al. 2004; Kim et al. 2013). In addition to older adults being more prone to sleep disturbances and disorders, risk appears to vary among racial groups. Specifically, African Americans have been found to have higher prevalence rates of sleep disturbance than Whites (Patel et al. 2010; Pigeon et al. 2011; Ruiter et al. 2011), including increased susceptibility to the development of sleep-disordered breathing and higher severity rates when diagnosed (Cohen-Zion et al. 2004; Redline et al. 1997). Having disturbed sleep or a sleep disorder is concerning in and of itself since the accompanying fatigue has been linked with dangerous public safety issues such as drowsy driving (Chen et al. 2014; Hossain and Shapiro 2002). Furthermore, sleep disturbances have been associated with higher rates of mental and physical health problems, cognitive impairment and even mortality (Ancoli-Israel 2009; Kim et al. 2015; Foley et al. 2004). Specific physical health and mental health problems that have been associated with sleep disturbances/disorders, especially in older adults, include depression, heart

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disease, and impaired physical functioning (Ancoli-Israel 2009; Kim et al. 2015; Foley et al. 2004).

Studies on positive psychology have revealed the possible interplay between positive psychological well-being and physiological functioning (Phelan et al. 2010; Ryff et al. 2004). Purpose in life is one of the major factors in positive psychological well-being (Ryff 1989; Ryff and Keyes 1995). Purpose in life is generally conceptualized as one's sense of meaning and directedness in his/her life, essentially having aspirations and goals for the future and feeling that experiences in life are meaningful (Ryff 1989; Ryff and Keyes 1995; Ryff 2014). Previous works have shown that purpose in life is independently linked to numerous positive health outcomes and healthy behaviors, as well as longevity (Kim et al. 2013; Boyle et al. 2009; Boyle et al. 2010a; Boyle et al. 2010b; Boyle et al. 2012; Krause 2009; Roepke et al. 2014). For example, having higher levels of purpose in life has been associated with a reduced risk of stroke (Kim et al. 2013), Alzheimer's disease (Boyle et al. 2010a; Boyle et al. 2012), disability (Boyle et al. 2010b), and all-cause mortality (Boyle et al. 2009; Krause 2009). Purpose in life, though trait-like, is dynamic and research suggests change in this construct is induced by psychological and social influences. It has been suggested via clinical intervention that purpose in life is a construct that can be consciously cultivated and enhanced (Ryff 2014; Burrow and Hill 2011).

A limited number of studies have examined the association between purpose in life and sleep. A cross-sectional examination of older women indicated that those with higher purpose in life showed less body movement during sleep—a proxy for better sleep quality (Ryff et al. 2004). In a second cross-sectional examination, it was reported that in middle aged adults, lower purpose in life was associated with problematic sleep duration (either excessive or inadequate hours of sleep) (Hamilton et al. 2006). In a final cross-sectional study it was demonstrated that after adjusting for demographic covariates and negative psychological states such as psychological distress, higher purpose in life scores were associated with fewer sleep problems in a sample of British civil servants (Steptoe et al. 2008). In the first longitudinal examination, the focus was on identifying subgroups of people and identifying their sleep trajectories over time. The researchers found that while there was an overall decline in sleep quality over time, individuals with higher baseline levels of purpose in life were least likely to be in the group with disrupted sleep (Phelan et al. 2010). Finally, a recent study by Kim, Hershner, & Strecher (Kim et al. 2015) found that higher purpose in life was associated with a reduction in incidence of sleep disturbances after adjusting for age, sex, education, race/ethnicity, health behaviors, physical functioning, and baseline level of sleep disturbance in a nationally representative sample of older adults (Kim et al. 2015). One shortcoming of these studies is the use of a general measure of sleep disturbance or sleep quality. It is unclear if purpose in life is associated with specific sleep disorders beyond poor sleep quality. Such a finding would indicate that the construct of purpose in life could have clinical utility. In addition, previous studies have not examined possible differences in race, which could be important given the elevated levels of sleep disturbances in older adults and African Americans.

The present study expands on previous work by including a cohort study of African Americans and extending deeper into specific types of sleep disturbances, including insomnia, sleep-disordered breathing, REM behavior disorder (RBD), and restless legs syndrome (RLS). The first aim of the study is to replicate previous findings by examining the relationship between purpose in life and sleep quality. The second aim of this study is to examine the relationship between purpose in life and symptoms of three common sleep disorders in older adults (sleep apnea, RLS, and RBD) in a community based bi-racial sample of older adults. It was hypothesized that higher levels of purpose in life would be associated with better sleep quality and lower risk of sleep disorders at baseline, as well as change in sleep quality and risk of sleep disorders at follow-up.

Methods

Participants

The sample for this study was pooled from two ongoing longitudinal epidemiological cohort studies of aging and cognition, the Minority Aging Research Study (MARS) and the Rush Memory and Aging Project (MAP). Both cohort studies were approved by the Rush University Medical Center Institutional Review Board and had similar recruitment techniques and operational methods.

MARS is a longitudinal community-based cohort study of risk factors for cognitive decline that enrolls older community dwelling African Americans without known dementia. Participants are recruited from community based organizations, churches, senior-subsidized housing facilities in the greater Chicago area, and the Clinical core of the Rush Alzheimer's Disease Center. All MARS participants signed an informed consent agreeing to annual clinical evaluations, as previously described (Barnes et al. 2012).

MAP (88% White) is a longitudinal clinical-pathologic cohort study of older adults that enrolls older community dwelling adults without known dementia who agree to brain autopsy at death. Participants were recruited from Chicago area retirement and senior-subsidized housing facilities. All MAP participants signed an informed consent agreeing to annual clinical evaluations

and organ donation, as previously described (Bennett et al. 2012).

At the time of analysis, 1195 (534 MARS; 661 MAP) individuals were enrolled in one of the cohort studies with complete baseline information. We excluded 274 (68 MARS; 206 MAP) individuals who did not have at least two clinical evaluations to measure change over time from their baseline assessment to a subsequent yearly follow-up. We also excluded 96 (38 MARS; 58 MAP) individuals who had more than 1 year between their baseline evaluation and first follow-up. The remaining 825 (428 MARS; 397 MAP) individuals were included in the analyses.

Purpose in life

Purpose in life was assessed at baseline using a modified 10-item measure derived from Ryff's and Keyes's scales of Psychological Well-Being (Ryff and Keyes 1995; Boyle et al. 2009). Individuals rated their agreement with each of the 10 items on a 5-point scale ranging from 1—strongly disagree to 5—strongly agree. Sample items included: "I feel good when I think of what I've done in the past and what I hope to do in the future" and "some people wander aimlessly through life, but I am not one of them." Scores are averaged to yield a mean score ranging from 1 to 5 with higher scores indicating higher levels of purpose in life.

Sleep quality and symptoms of sleep disorders

Sleep quality and the possible presence of sleep disorders were assessed using a 32-item questionnaire derived from three validated sleep measures, the Pittsburgh Sleep Quality Index (PSQI; (Buysse et al. 1989)), the Berlin Questionnaire (Redline and Strohl 1998) and the Mayo Sleep Questionnaire (MSQ; (Boeve et al. 2002)). Participants were given the sleep questionnaire with an addressed and stamped envelope at the end of their annual visit and were instructed to complete the questionnaire and return it via the stamped envelope.

Sleep Quality was measured using a modified version of the PSQI that assessed 6 components of sleep rather than the original 7 (all but the "Sleep Quality" component was assessed). Additionally, adjustments were made with regard to specific questions in order to avoid redundancy and over taxing of the older adult cohort (see (Turner et al. 2016) for full description of scale). The sum of the 6 components ranges from 0 to 16 with higher scores indicating poorer sleep quality (Turner et al. 2016). Sleep apnea risk was assessed using the Berlin Questionnaire, which was scored as previously published and validated (Netzer et al. 1999), indicating either a high or low risk for sleep apnea (Turner et al. 2016). Consistent with previous work (Rongve et al. 2010), the possible presence of Restless Leg Syndrome (RLS) was measured using questions 2 and 3 from the MSQ (Turner et al. 2016). In addition, the MSQ was also used to assess for REM Behavior Disorder (RBD) via questions 1a–e, scored as previously published and validated (Turner et al. 2016; Boeve et al. 2011).

Demographic covariates

Other variables used in the analyses included demographic variables of age, sex, years of education, and race.

Data analysis

Analyses were conducted utilizing the Statistical Package for the Social Sciences software version 23 (IBM and Statistical Package for the Social Sciences (SPSS) (SPSS) 2015). Statistical significance was set at alpha = 0.05. Frequency and descriptive analyses were conducted to identify missing data, outliers, means, and standard deviations across all demographic and study variables.

Individuals undergo annual clinical assessments, therefore, to identify change over time in the continuous variable of sleep quality, change scores were derived by subtracting the baseline score from each yearly follow-up (i.e. next annual clinical evaluation) score. Thus change score 1 is the change in sleep quality from baseline to 1-year follow-up, and so forth, for a total of three change scores across all sleep-related outcomes.

To determine if purpose in life independently predicted baseline sleep quality or change in sleep quality over time we conducted a series of hierarchical linear multiple regressions. The first step of each model included the demographic covariates age, sex, race, and years of education, and the second step included the covariates and purpose in life. In order to determine if purpose in life was associated with symptoms of sleep apnea, RLS and/or RBD at baseline and at follow-up time points 1–3 we conducted a series of hierarchical logistic regression analyses controlling for age, sex, race, and years of education.

Results

The majority of the 825 respondents were female (77.3%), a little more than half (53.7%) were African American, age ranged from 60.84 to 99.81 with a mean of 79.02 (SD = 7.46), and participants had an average of 15.14 (SD = 3.07) years of education. At baseline the respondents' sleep quality was slightly disturbed (modified PSQI mean score = 5.93 ± 2.81; Table 1). Approximately 42% of participants were at high risk for sleep apnea and approximately a quarter of the sample (23.6%) endorsed symptoms of RLS. A lower proportion of participants (7.0%) endorsed symptoms of RBD (see Table 1).

Hierarchical multiple linear regression was conducted to determine if purpose in life independently predicted

Table 1 Frequencies, means, and standard deviations among sleep variables

	Baseline *n* = 825		1-year Follow-Up *n* = 825		2-year Follow-Up *n* = 554		3-year Follow-Up *n* = 247	
	Mean (SD)/*N*(%)	Range	Mean (SD)/*N*(%)	Range	Mean (SD)/*N*(%)	Range	Mean (SD)/*N*(%)	Range
Sleep Quality Total Score	5.93 (2.81)	0–15	5.92 (2.89)	0–14	5.86 (2.91)	0–14	5.94 (2.91)	0–15
High Sleep Apnea Risk	346 (41.9%)		341 (41.3%)		225 (27.3%)		100 (12.1%)	
High Restless Leg Syndrome Risk	195 (23.6%)		189 (22.9%)		137 (16.6%)		48 (5.8%)	
High REM Behavior Disorder Risk	58 (7.0%)		60 (7.3%)		41 (5.0%)		28 (3.4%)	

baseline sleep quality. Analyses indicated that at step 1, the covariate race contributed significantly to the regression model, [$F_{(4809)} = 2.408$, $p = .048$], and accounted for 1.2% of the variance in sleep quality. Introducing purpose in life in step 2 explained an additional 4.3% of the variance in sleep quality. This change in R^2 was significant, [$F_{(5808)} = 9.383$, $p < .001$] (see Table 2).

Hierarchical linear multiple regression was also used to determine whether purpose in life predicted change in sleep quality from baseline to 1-year follow-up. Analyses indicated that at step 1 no covariates contributed significantly to the regression. While introducing purpose in life in step 2 did not result in the model being statistically significant, the individual predictor purpose in life predicted change in sleep quality from baseline to the first follow-up assessment ($t = 2.344$, $p = .019$), such that for every unit increase in purpose in life there was an increase in change in sleep quality from baseline to 1-year follow-up by 0.449 units ($\beta = .449$, $p = 0.019$) (see Table 2). No significant relationships were found between purpose in life and change in sleep quality from baseline to 2-year or 3-year follow-up.

A series of hierarchical logistic regressions adjusting for the demographic covariates of age, sex, race, and years of education were conducted to determine if purpose in life was associated with risk of sleep apnea. Regression analyses for baseline revealed that in step 1 only the covariate age significantly contributed to the model, which accounted for 2.9% of the variance (Nagelkerke $R^2 = .029$, $X^2_{(4)} = 17.71$, $p = .001$) of sleep apnea risk, with increasing age being associated with a decreased likelihood of risk of sleep apnea (OR .965, 96% CI .945–.985). In step 2 introducing purpose in life explained an additional 1.3% of the variance (Nagelkerke $R^2 = .042$, $X^2_{(5)} = 25.41$, $p < .001$) of risk of sleep apnea, with increasing levels of purpose in life being associated with decreased risk of sleep apnea (OR .630, CI 95% .454–.875) (see Table 3). Similarly, at 1-year follow-up, regression analyses showed age was the only significant covariate in step 1; the model accounted for 2.9% of the variance (Nagelkerke $R^2 = .029$, $X^2_{(4)} = 17.56$, $p = .002$) of sleep apnea risk, with increasing age being associated with a decreased likelihood of risk of sleep apnea (OR .963, 96% CI .943–.983). Adding purpose in life in step 2 explained an additional 0.6% of the variance (Nagelkerke $R^2 = .035$, $X^2_{(5)} = 21.61$, $p = .001$) of risk of sleep apnea, with increasing levels of purpose in life being associated with decreased risk of sleep apnea (OR .719, CI 95% .520–.993) (see Table 3). Regression analyses for 2-year follow-up also revealed similar results, in step 1 age was the only significant covariate, the model accounted for 2.5% of the variance (Nagelkerke $R^2 = .025$, $X^2_{(4)} = 10.36$, $p = .035$) of sleep apnea risk, with increasing age being associated with a decreased likelihood of risk of sleep apnea (OR .973, 96% CI .948–1.000). Introducing purpose in life in step 2 explained an additional 1.3% of the variance (Nagelkerke $R^2 = .038$, $X^2_{(5)} = 15.82$, $p = .007$) of risk of sleep apnea, with increasing levels of purpose in life being associated with decreased risk of sleep apnea (OR .604, CI 95% .395–.925) (see Table 3). The logistic regression analysis for sleep apnea risk at 3-year follow-up was not significant.

A series of hierarchical logistic regressions controlling for the demographic covariates of age, sex, race, and years of education were also conducted to determine if purpose in life was associated with RLS symptoms. Purpose in life did not significantly predict possible RLS at baseline (see Table 4). However, at 1-year follow-up regression analyses revealed that at step 1 no covariates contributed significantly to the regression, but, introducing purpose in life in step 2 explained 2.7% of the variance (Nagelkerke $R^2 = .027$, $X^2_{(5)} = 14.69$, $p = .012$) of RLS symptoms, with increasing levels of purpose in life being associated with a decreased likelihood of having possible RLS (OR .524, 95% CI .361–.762) (see Table 4). For 2-year follow-up regression analyses revealed that at step 1, no covariates contributed significantly to the regression. However, introducing purpose in life in step 2 explained 4.5% of the variance (Nagelkerke $R^2 = .045$, $X^2_{(5)} = 17.11$, $p = .004$), with increasing purpose in life being associated with a decreased likelihood of having possible RLS (OR .396, 95% CI .245–.639) (see Table 4). The logistic regression analyses for RLS symptoms at 3-year follow-up was not significant (see Table 4).

The series of hierarchical logistic regression analyses for possible presence of RBD at baseline, 1-year follow-up, 2-year follow-up and 3-year follow-up all yielded non-significant results.

Discussion

In a bi-racial sample of over 800 older adults the present findings provide support for the hypothesis that purpose

Table 2 Hierarchical Multiple Linear Regression Analyses of Purpose in Life and Sleep Quality

		B	SE	β	*p*	F	R^2
Sleep Quality at Baseline *(n = 814)*	Step 1					**$2.41_{(4)}$***	**.012**
	Sex	−.324	.234	−.049	.167		
	Years of Education	−.016	.032	−.018	.618		
	Age	.004	.014	.012	.755		
	Race	**.534**	**.210**	**.095**	**.011**		
	Step 2					**$9.383_{(5)}$****	**.055**
	Sex	−.298	.229	−.045	.193		
	Years of Education	.023	.032	.026	.471		
	Age	−.016	.014	−.042	.261		
	Race	**.548**	**.206**	**.097**	**.008**		
	Purpose in Life	**−1.326**	**.218**	**−.220**	**.000**		
Sleep Quality Change Baseline to 1-Year Follow-up *(n = 814)*	Step 1					$.556_{(4)}$	.003
	Sex	−.119	.202	−.021	.555		
	Education	−.029	.028	−.037	.293		
	Age	−.011	.012	−.034	.367		
	Race	−.074	.181	−.407	.684		
	Step 2					$1.546_{(5)}$	.009
	Sex	−.128	2.01	−.022	.526		
	Years of Education	−.043	.028	−.055	.132		
	Age	−.004	.012	−.012	.746		
	Race	−.078	.180	−.016	.665		
	Purpose in Life	**.449**	**.192**	**.087**	**.019**		
Sleep Quality Change Baseline to 2-Year Follow-up *(n = 550)*	Step 1					$.857_{(4)}$	.006
	Sex	.098	.245	.017	.689		
	Education	−.032	.034	−.040	.352		
	Age	.018	.016	.050	.269		
	Race	.265	.226	.053	.240		
	Step 2					$.855_{(5)}$	.008
	Sex	.087	.245	.015	.724		
	Years of Education	−.039	.035	−.049	.270		
	Age	.021	.016	.058	.205		
	Race	.261	.226	.052	.249		
	Purpose in Life	.235	.255	.041	.357		
Sleep Quality Change Baseline to 3-Year Follow-up *(n = 245)*	Step 1					$.593_{(4)}$	.012
	Sex	−.398	.357	−.072	.266		
	Education	.014	.054	.016	.801		
	Age	.007	.025	.018	.787		
	Race	.412	.345	.081	.234		
	Step 2					$.693_{(5)}$	.013
	Sex	−.388	.358	−.071	.279		
	Years of Education	.022	.057	.026	.702		
	Age	.003	.026	.008	.914		
	Race	.396	.347	.078	.255		
	Purpose in Life	−.183	.363	−.036	.615		

Four separate regression analyses. * = $p \leq .05$, ** = $p \leq .01$, bolding is used to emphasize significant predictors within the models

Table 3 Hierarchical Multiple Logistic Regression Analyses of purpose in life and risk of sleep apnea

		β	SE	*p*	Odds ratio	95% CI	X^2	Nagelkerke R^2
Risk of Sleep Apnea at Baseline *(n = 808)*	Step 1						**$17.707_{(4)}$****	**.029**
	Sex	.282	.172	.101	1.325	.947–1.856		
	Years of Education	−.053	.024	.028	.348	.904–.994		
	Age	**−.036**	**.010**	**.001**	**.365**	**.945–.985**		
	Race	−.252	.155	.104	.778	.574–1.053		
	Step 2						**$25.408_{(5)}$****	**.042**
	Sex	.294	.173	.089	1.341	.956–1.881		
	Years of Education	−.040	.025	.102	.961	.915–1.008		
	Age	**−.043**	**.011**	**.000**	**.957**	**.937–.978**		
	Race	−.248	.156	.111	.780	.575–1.059		
	Purpose in Life	**−.462**	**.168**	**.006**	**.630**	**.454–.875**		
Risk of Sleep Apnea at 1-Year Follow-Up *(n = 810)*	Step 1						**$17.563_{(4)}$****	**.029**
	Sex	.187	.171	.274	1.206	.862–1.688		
	Years of Education	−.036	.024	.132	.965	.920–1.011		
	Age	**−.038**	**.011**	**.000**	**.963**	**.943–.983**		
	Race	−.002	.154	.990	.998	.737–1.351		
	Step 2						**$21.608_{(5)}$***	**.035**
	Sex	.195	.172	.257	1.215	.867–1.702		
	Years of Education	−.026	.024	.282	.974	.929–1022		
	Age	**−.043**	**.011**	**.000**	**.958**	**.937–.978**		
	Race	.001	.155	.996	1.001	.739–1.356		
	Purpose in Life	**−.331**	**.165**	**.045**	**.719**	**.520–.993**		
Risk of Sleep Apnea at 2-Year Follow-Up *(n = 548)*	Step 1						**$10.360_{(4)}$***	**.025**
	Sex	.296	.203	.146	1.344	.903–2.002		
	Years of Education	−.045	.029	.124	.956	.903–1.012		
	Age	**−.027**	**.014**	**.047**	**.973**	**.948–1.000**		
	Race	.175	.189	.354	1.191	.823–1.724		
	Step 2						**$15.816_{(5)}$****	**.038**
	Sex	.322	.205	.116	1.380	.924–2.060		
	Years of Education	−.030	.030	.312	.971	.916–1.028		
	Age	**−.034**	**.014**	**.016**	**.967**	**.941–.994**		
	Race	.184	.190	.332	1.202	.829–1.743		
	Purpose in Life	**−.503**	**.217**	**.020**	**.604**	**.395–.925**		
Risk of Sleep Apnea at 3-Year Follow-Up *(n = 242)*	Step 1						$3.983_{(4)}$	.022
	Sex	−.056	.307	.856	.946	.518–1.728		
	Years of Education	−.033	.047	.479	.967	.882–1.060		
	Age	−.032	.022	.142	.969	.928–1.011		
	Race	.154	.299	.607	1.167	.649–2..097		
	Step 2						$4.094_{(5)}$	.023
	Sex	−.051	.308	.869	.951	.520–1.738		
	Years of Education	−.029	.049	.556	.972	.883–1.069		
	Age	−.034	.022	.132	.967	.925–1.010		
	Race	.147	.300	.625	1.158	.643–2.085		
	Purpose in Life	−.104	.312	.739	.901	.489–1.661		

Four separate regression analyses. * = $p \leq .05$, ** = $p \leq .01$, bolding is used to emphasize significant predictors within the models

Table 4 Hierarchical Multiple Logistic Regression Analyses of Purpose in Life and Possible Presence of RLS

		β	SE	*p*	Odds ratio	95% CI	X^2	Nagelkerke R^2
Possible presence of RLS at Baseline *(n = 814)*	Step 1						$8.189_{(4)}$	.015
	Sex	−.315	.208	.131	.730	.485–1.098		
	Years of Education	−.043	.028	.129	.958	.906–1.013		
	Age	.019	.012	.109	1.019	.996–1.043		
	Race	.043	.179	.808	1.044	.735–1.483		
	Step 2						**$11.758_{(5)}$***	**.022**
	Sex	−.307	.209	.141	.736	.489–1.108		
	Education	−.032	.029	.263	.968	.915–1.025		
	Age	.014	.012	.263	1.014	.990–1.038		
	Race	.050	.180	.782	1.051	.739–1.494		
	Purpose in Life	−.355	.188	.059	.701	.485–1.013		
Possible presence of RLS at 1-Year Follow-Up *(n = 814)*	Step 1						$3.105_{(4)}$	.006
	Sex	−.087	.203	.667	.916	.616–1.364		
	Years of Education	−.045	.028	.111	.956	.904–1.010		
	Age	−.002	.012	.884	.998	.975–1.021		
	Race	−.117	.179	.514	.890	.626–1.264		
	Step 2						**$14.688_{(5)}$****	**.027**
	Sex	−.073	.204	.722	.930	.623–1.388		
	Years of Education	−.026	.029	.367	.974	.920–1.031		
	Age	−.012	.012	.326	.988	.964–1.012		
	Race	−.109	.181	.547	.897	.629–1.279		
	Purpose in Life	**−.646**	**.191**	**.001**	**.524**	**.361–.762**		
Possible presence of RLS at 2-Year Follow-Up *(n = 550)*	Step 1						$2.218_{(4)}$	.006
	Sex	−.196	.237	.407	.822	.517–1.307		
	Years of Education	−.026	.033	.422	.974	.913–1.039		
	Age	−.004	.015	.808	.996	.967–1.026		
	Race	−.204	.211	.334	.816	.539–1.234		
	Step 2						**$17.106_{(5)}$****	**.045**
	Sex	−.148	.240	.538	.862	.539–1.380		
	Years of Education	.001	.034	.979	1.001	.937–1.069		
	Age	−.015	.016	.319	.985	.955–1.015		
	Race	−.184	.214	.390	.832	.546–1.266		
	Purpose in Life	**−.927**	**.244**	**.000**	**.396**	**.245–.639**		
Possible presence of RLS at 3-Year Follow-Up *(n = 245)*	Step 1						$4.132_{(4)}$	.027
	Sex	−.696	.425	.102	.499	.217–1.148		
	Years of Education	.005	.058	.938	1.005	.897–1.125		
	Age	.012	.026	.641	1.012	.963–1.064		
	Race	−.348	.355	.327	.706	.352–1.417		
	Step 2						$4.138_{(5)}$	.027

Table 4 Hierarchical Multiple Logistic Regression Analyses of Purpose in Life and Possible Presence of RLS *(Continued)*

Sex	−.694	.426	.103	.500	.217–1.151
Years of Education	.006	.061	.922	1.006	.893–1.133
Age	.011	.027	.675	1.011	.959–1.066
Race	−.350	.357	.326	.705	.350 −1.417
Purpose in Life	−.030	.381	.936	.970	.460–2046

Four separate regression analyses. * = $p \leq .05$, ** = $p \leq .01$, bolding is used to emphasize significant predictors within the models, *RLS* Restless Leg Syndrome

in life is related to sleep quality with indications that it could be a potentially useful clinical tool for assessing older adults. We found that higher levels of purpose in life at baseline predicted better sleep quality at baseline as well as increased change in sleep quality over a 1-year period, a finding that is consistent with previous studies (Kim et al. 2015; Phelan et al. 2010; Ryff et al. 2004; Hamilton et al. 2006; Steptoe et al. 2008). Furthermore, these findings are consistent with anecdotal observations that people who have meaning and purpose in their waking activities appear to sleep well at night. It appears that for both African American and White American older adults, the more meaning and purpose one has in daytime activities, the better one tends to sleep at night. Collectively, the emerging data indicates the benefits of positive psychology on sleep health.

To our knowledge, this study is the first to demonstrate a relationship between purpose in life and the risk for symptoms of common sleep disorders in older adults. We found that higher levels of purpose in life were generally protective against the occurrence of sleep apnea and RLS as well as the onset of sleep apnea and RLS over the following 1 to 2 years. One interpretation of our findings is that individuals with a high purpose in life tend to have better overall mental and physical health. The premise of positive psychological well-being includes the notion that improved well-being will be accompanied by the optimal functioning of the persons' physiological systems (Phelan et al. 2010; Ryff et al. 2004). Also research has indicated that individuals who are high in components of psychological well-being other than purpose in life such as positive affect have fewer physical symptoms and better overall health (Fredman et al. 2014). Research by Ancoli-Isreal suggests a strong association between sleep difficulties and cardiac disease (Ancoli-Israel 2009), this research also posits that comorbidities associated with aging, such as medical and psychiatric illness, like cardiac disease and depression, foster the decreased ability to sleep in older adults rather than increasing age alone. Therefore, the protective factor we are seeing with purpose in life at baseline for sleep quality and sleep apnea (as well as a trending result for RLS) may be a consequence of fewer medical comorbidities (Ryff et al. 2004). Another possibility is that individuals with higher levels of purpose in life tend to engage in more healthy behaviors. For example, studies have shown that people with more purpose in life are more likely to exercise, participate in preventative behaviors, such as doctor visits, and seek out adequate relaxation (Holahan et al. 2008; Kim et al. 2014; Holahan et al. 2011). It is possible that engagement in these types of healthy behaviors by the individuals who are high in purpose in life could lead to reduced risk of developing sleep apnea and RLS symptoms.

Our findings should be interpreted with some limitations. First, our findings are based on self-report, which are open to recall bias and subjective interpretation of sleep symptoms. Also, though this is a community-based sample, the educational attainment status of the sample is relatively high and it is possible that these higher levels of educational attainment may reflect a healthier population with higher levels of purpose in life and less severe sleep problems, as well as, greater access to health care. It is also possible that given the higher levels of educational attainment, this sample was more inclined engage in behaviors related to a healthier lifestyle, as research has suggested that in older adults in the United States, higher socioeconomic status, especially as measured via educational attainment, has been associated with choosing healthier lifestyle behaviors, specifically healthy diet choices and increased physical exercise (Kim et al. 2004). In addition, the proportion of those with RBD was relatively low (7% of the sample), which might have limited power to detect changes over time. Finally, while our analyses revealed statistical significance at the $p < .001$ level on several analyses, the amount of variance explained is relatively low. Therefore, future research should examine the magnitude of the effects relative to other known risk factors for sleep disturbances in older adults.

Conclusion

Despite these limitations, this study has several important advances. First, we examined the relationship between purpose in life and risk of specific sleep disorders. In addition, we had a large sample size of over 800 older

adults that included a large proportion of African Americans (53.7%), greatly increasing the generalizability of our findings. Finally, these findings indicate that the construct of purpose in life may have utility in a clinical setting. When evaluating older adults for sleep issues, assessing for purpose in life could provide insights into sleep quality, the presence of sleep apnea, and to a lesser degree RLS. Further investigation into possible mechanisms on purpose in life and other benefits of positive psychology and sleep health are needed. For instance research should examine the link between purpose in life and specific symptoms of insomnia, such as nocturnal symptoms versus daytime symptoms. This could help identify potential mechanisms for the impact of positive psychology on insomnia. Moreover, future research could examine the use of interventions using positive psychology to target purpose in life in older adults. For example, mindfulness-based therapies (Ong 2016) and Acceptance and Commitment Therapies (Dalrymple et al. 2010) include values and cultivation of compassion that could enhance purpose in life (Ong et al. 2012).

Abbreviations

MAP: Memory and Aging Project; MARS: Minority Aging Research Study; MSQ: Mayo Sleep Questionnaire; PSQI: Pittsburgh Sleep Quality Index; RBD: REM Behavior Disorder; RLS: Restless Leg Syndrome

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Availability of data and materials

Data supporting the results reported in this article can be obtained from the Rush Alzheimer's Disease Center through their "Research Resource Sharing Hub" at https://www.radc.rush.edu/.

Authors' contributions

ADT was a major contributor in the idea conception for the manuscript, analyzing and interpreting the data as well as writing the manuscript. CES was a major contributor in analyzing and interpreting data. JCO was a major contributor in the conception of the manuscript and review and revision of the manuscript for intellectual content. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

Consent for publication

Not Applicable.

Ethics approval and consent to participate

All procedures performed in this study involving human participants were done so in accordance with the ethical standards of the Rush University Medical Center Institutional Review Board and with the 1964 Helsinki declaration and its later amendments. Informed consent to participate was obtained from each participant prior to study enrollment.

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