Journal of Behavioral Sciences, Vol. 32, No. 1, 2022

Neuropsychological Functioning in Gilgit-Baltistan Elderly

Rabia Hussain
Behavioural Sciences Department, Karakoram International University, Gilgit, Pakistan.
***Najma Najam, PhD**
Institute of Applied Psychology, University of Punjab, Lahore, Pakistan.
Maryam Kamran, PhD
College of Natural Resources and Environment, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, USA.

This study assessed the neuropsychological functioning of elderly living in high altitude regions of Gilgit and Skardu, Gilgit-Baltistan, Pakistan using Mini-Mental State Examination (MMSE), Stroop Neuropsychological Screening Test (SNST), and Dementia Rating Scale-2 (DRS-2) were translated in Urdu. Participants were selected through snow-ball sampling that included 63 males and 28 females ($N = 91$) with an age range of 60-83 years. The reliability of instruments ranged from moderate to high levels (Cronbach α =.51 to .83). Results revealed elderly performance was poor in cognition suggesting poor frontal lobe functioning. Statistical analyses showed a strong positive relationship between dementia with mental state and overall cognitive functioning. Findings also indicated differences in cognitive deficits in Gilgit elders and poor frontal lobe functioning in Balti elders, with stronger effects observed in females. Findings indicate the need for interventions and support for the elderly.
Keywords. Cognitive Functions, Dementia, Elderly, High Altitude, Neuropsychological.

---

*Correspondence concerning this article should be addressed to Prof. Dr. Najma Najam, Ph.D., Professor Emeritus, Institute of Applied Psychology, University of Punjab, Lahore, Pakistan. Email: najamnajma@yahoo.com. Rabia Hussain, Behavioural Sciences Department, Karakoram International University, Gilgit, Pakistan and Maryam Kamran, Ph.D., College of Natural Resources and Environment, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, USA.

The elderly population faces challenges that range from getting fundamental rights to accessing basic resources that require understanding and adequate support systems in developing countries such as Pakistan (Sabzwari & Azhar, 2010). Adamsons et al. (2020) report that the elderly population is rapidly increasing in China, Pakistan, and other South Asian countries. In the absence of governmental policies in Pakistan for the needs of the elderly, research is needed to examine aging issues in detail (Vertejee & Karamali, 2014). Pakistan is a developing country where medical facilities and other related resources are hard to come by to support effective diagnosis, treatment, and follow-up care for elders who suffer from neurological impairments and dementia (Adamsons et al., 2020; Khan, et al., 2014).

These issues are exacerbated for elderly individuals living in rural mountainous regions like the province of Gilgit-Baltistan (elevation: 1500-2230m), and risk factors for cognitive deficits in the elderly include, age and education (demographic factors), smoking, and diet (lifestyle factors), nature of the disease and current state of disease (health-related factors) affect cognitive functioning (Almeida et al., 2002; Forette et al., 2002; Hamano et al., 2015; Lee et al., 2003; Morris et al., 2006; Qiu et al., 2003; Shumaker et al., 2004). Hamano et al. (2015) reported elderly living at high elevations in Japan suffer from significant cognitive deficits, which are similar to older disabled individuals living in the mountains of Northern India (Young, 2016). Acute hypoxemia (below-normal level of oxygen in the blood at high elevations) can decrease attention, information processing, memory, and executive functioning (Davranche et al., 2016; Kramer et al., 1993; Limmer & Platen, 2018; Ochi et al., 2018; Pun et al., 2018; Pun et al., 2019).

Literature Review

By the year 2050, 12% of Pakistan's population (approximately 43 million) will compromise of elderly citizens (Ahmed et al., 2015). We need to start assessing the neuropsychological functions of this demographic today so that we are better prepared to support them in the future. There are but a handful of studies available on the psychological (Ahmed et al., 2015; Ali & Kiani, 2003; Ashiq & Asad, 2017; Chaudhry

et al., 2014; Najam et al., 2014; Najam et al., 2015) and neuropsychological functioning (Noor & Najam, 2009; Noor-ul-ain & Kausar, 2012) in the elderly living in various regions of Pakistan; the number of studies who live in mountainous regions. Thus, a need is there to examine difficulties and their effects faced by the elderly in these mountainous regions of Pakistan.

Those living in harsh conditions or stricken by poverty may suffer from malnutrition, poor physical health overall, and psychological dysfunction (Irshad et al., 2015). Baig et al. (2000) report geriatric specific conditions and debilitating syndromes that include loss of muscle mass, increase in falls, and other immobility disorders. In other cases, the elderly may also suffer from chronic diseases like diabetes, hypertension, and heart diseases (Saleem et al., 2009), nutritional challenges (Van & Funderburg, 2003), and loss of independent functioning along with depression (Ganatra et al., 2008; Penninx et al., 2003).

Increase in the aging population creates physical, economic, and social challenges. The elderly depend on their caregivers for safety, physical and social needs, and when caregiving is poor, neglect and physical abuse increase (Dildar et al., 2012). Additionally, there is also an increase in psychological disorders, economic inactivity or dependence on others, which includes isolation from family and community affairs (Irshad et al., 2015). If caregiving is effective, it ensures normal functioning and better quality of life for the elderly (Qidwai & Ashfaq, 2011).

When age-related cognitive and physical deficits were assessed in the context of social support in the elderly of Lahore, researchers found a significant positive relationship between cognitive function and social support, which led to a better quality of life, whereas the strength of coping was positively associated with physical deficits (Noor-ul-ain & Kausar, 2012). Noor and Najam (2009) reported significant deficits in working and visual memory of elderly but not verbal memory in elderly living in Rawalpindi. A host of other conditions such as amnesia, depression, dementia, sadness, sleeplessness, and Alzheimer's disease have been reported as well (Irshad et al., 2015).

There were a number of reasons for selecting Gilgit and Skardu for the present research including the high elevation, cultural and ethnicity

diversity, languages, occupations, tourism, and religious practices. Gilgit and Skardu are 139km apart and are connected by a road that passes through the Rondu district. Both cities have airports, but Skardu attracts climbers, mountaineers, hikers, and trekkers at national and international levels. The rugged terrain makes these individuals tough and they rely greatly on natural resources for sustenance and call themselves mountain communities.

Since 2009, Gilgit has been the capital city of the province, and holds dynamic, strategic, political, bureaucratic, and trade centers. Gilgit is the home of Shins, Yashkuns, Kashmiris, Kashgaris, Pamiris, Pathans, and Kohistanis with the majority speaking Shina, however, people from other districts residing in Gilgit speak Brushuski, Wakhi, and Khowar. Skardu is another major city of Gilgit-Baltistan that is primarily Tibetan in descent and speak Balti, a Tibetan language that extends to Ladakh (now part of China) and Leh (extends to India). Main occupations in Gilgit are farming and agriculture, shepherd herding, general labor, mining, trade, transport, and hospitality industry; others engage in services to government or non-governmental organizations. Baltis are mountaineers, miners, tour guides, and porters with now more workers in the hospitality industry than before. In terms of religious affiliations, Gilgiti subscribe to Shiite, Sunni, and Ismaili sects whereas Baltis are predominantly Shiite, Nurbakhshi Shiites, and Sufis.

In an earlier investigation, psychological, emotional, and cognitive challenges encountered by the elderly in two provinces of Pakistan, Punjab (Lahore and Multan) and Gilgit-Baltistan (Gilgit and Skardu) were reported by Najam et al. (2014). Results showed that the elderly of mountain communities actively engaged in their daily-life activities such as community participation, domestic work, farming, and breeding of domestic animals. However, they reported difficulties in self-efficacy and cognitive functioning. Poor physical health of the elderly was found to be associated with geriatric depression, anxiety, and stress (Najam et al., 2015). These authors reported elderly in Multan (Southern Punjab) had higher levels of social support, and forgiveness; and lower levels of stress, anxiety, depression, and negative affect compared to the elderly from Lahore (Northern Punjab), In addition, the authors found elderly from rural

Multan had better psychological and emotional functioning, the better quality of life and adequate mental wellbeing compared to elderly from urban Lahore. In Gilgit-Baltistan, the elderly in Gilgit reported greater perceived social support, low anxiety, and low social avoidance to elderly from Skardu; were elderly men from Gilgit and Skardu reported greater self-worth compared to elderly women. Balti elderly suffered from significantly higher geriatric depression compared to Gilgiti elderly, and Balti elderly women experienced greater anxiety and Gilgiti elderly women.

The present study was carried out to assess the neuropsychological functions in elders of Gilgit and Skardu. Age-related neurological deficits are manifested as cognitive declines, which should be examined by culturally appropriate neuropsychological tests; no standardized tests are available for Gilgit and Skardu, therefore this study adapted neuropsychological instruments to make assessments of the cognitive declines. No formal and systematic study has been documented to date on the neurological functioning in the elderly of Gilgit-Baltistan with comparison across the various communities within the regions, gender, income, and occupation.

Method

Sample

A sample of hundred elderly individuals was drawn from Gilgit (N = 50) and Skardu (N = 50) through snow-ball sampling; however, data from seven participants were discarded due to incomplete responses. The purpose of selecting the elderly through the snowball sampling technique was to identify the educated or potential elderly participants who could respond to the items of cultured fair neuropsychological tests. Thus, elderly participants who knew such elderly participants encouraged them to participate in this present study. Further, the responses of caregivers were not considered or allowed to influence any response or choice of the answer by the elderly.

Inclusion criteria of selecting elderly participants are i) Elderly living in the communities of Gilgit and Skardu; ii) Elderly living with families, and iii) Individuals above 60 years age. The exclusion criteria of

selecting participants are i) Elderly with chronic diseases that persist for a long time or are constantly recurring; ii) Elderly with severe cognitive impairment; iii) Elderly with physical disabilities or paralysis, and iv) living in old homes.

The final sample comprised of 91 elderly participants; among these 52 (57%) elderly men from Gilgit and 39 (43%) from Skardu; 63 (69%) were men and 28 (31%) women with ages that ranged from 60 to 83 years. Participants would be excluded if they had chronic diseases, severe cognitive impairments, and had physical disabilities or paralysis, or lived in old age homes. No such individuals were solicited in our initial sample of 100 people (see Table 1).

Table 1

Demographic Characteristic of Elderly Participants

Variable	Gilgit Elders *(n = 52)*	Balti Elders *(n = 39)*	Total	X^2, *p*
	f (%)	*f (%)*	*f (%)*	
Gender				.21, .65
Women	17 (19)	11 (12)	28 (31)	
Men	35 (38)	28 (31)	63 (69)	
Total	52 (57)	39 (43)	91(100)	
Age of participants				3.46, .17
60 to 70 years	45 (49)	28 (30.8)	73 (80.2)	
70 to 80 years	6 (7)	8 (8.8)	14 (15.4)	
80 years and above	1 (1)	3 (3.3)	4 (4.4)	
Total	52 (57)	39 (42.9)	91 (100)	
Marital Status				5.37, .02
Married	50 (56)	35 (39)	85 (95)	
Widow	0 (0)	4 (4)	4 (4)	
Not Reported	2 (2)			
Occupation				21, .00
Farming & Livestock	8 (9)	22 (25)	30 (34)	

Household chores	9 (10)	7 (8)	16 (18)	
Small business	8 (9)	3 (3)	11 (12)	
Social/community work	4 (4)	0 (0)	4 (4)	
Other work	6 (7)	4 (4)	10 (11)	
No work	11 (12)	3 (3)	14 (16)	
Farming-household chores	4 (4)	0 (0)	4 (4)	
Not Reported	2 (2)			
Income				3.09, .37
Rs. 10,000 and below	36 (39)	20 (22)	56 (61)	
Rs. 10000 – 25000	7 (8)	8 (9)	15 (16)	
Rs. 25000 – 50000	7 (8)	9 (10)	16 (17)	
Rs. 50000 and above	2 (2)	2 (2)	4 (4)	
Total	52 (57)	39 (43)	91 (100)	
Family Income				8.31, .04
Rs. 10,000 and below	4 (4)	12 (13)	16 (18)	
Rs. 10000 – 25000	12 (13)	6 (7)	18 (20)	
Rs. 25000 – 50000	16 (17)	10 (11)	26 (28)	
Rs. 50000 and above	20 (22)	11 (12)	31 (34)	
Total	52 (57)	39 (43)	91 (100)	
Living with				6.97, .13
Alone	1 (1)	1 (1)	2 (2)	
With Spouse	3 (3)	6 (7)	9 (10)	
With Children –not joint	0 (0)	2 (2)	2 (2)	
With Children – joint	48 (53)	29 (32)	77 (85)	
With relative	0 (0)	1 (1)	1 (1)	
Total	52 (57)	39 (43)	91 (100)	
Head of the House				7.35, .19

Self	37 (41)	26 (29)	63 (69)	
Husband	13 (14)	7 (8)	20 (22)	
The Eldest Son	2 (2)	1 (1)	3 (3)	
Father	0 (0)	1 (1)	1 (1)	
The Eldest Brother	0 (0)	3 (3)	3 (3)	
Other Relative	0 (0)	1 (1)	1 (1)	
Total	52 (57)	39 (43)	91 (100)	
Assistance Devices				12.7, .02
Auditory device	1 (1)	0 (0)	1 (1)	
Glasses	12 (13)	16 (18)	28 (31)	
Walking Stick	3 (3)	4 (4)	7 (8)	
Any other devices	0 (0)	3 (3)	3 (3)	
No devices	36 (40)	15 (16)	51 (56)	
Both glasses & walking stick	0 (0)	1 (1)	1 (1)	
Total	52 (57)	39 (43)	91 (100)	
Physical Illness				9.78, .04
Diabetics	5 (5)	0 (0)	5 (5)	
Joint pain	11 (12)	13 (14)	24 (26)	
Other physical illnesses	6 (7)	10 (11)	16 (18)	
No illness	28 (31)	18 (20)	44 (50)	
Mental Illness				.88, .65
Excessive worries	3 (3)	3 (3)	6 (7)	
Anxious	1 (1)	0 (0)	1 (1)	
No mental illnesses	48 (53)	36 (40)	84 (92)	

Instruments

Demographic Sheet. A self-designed demographic information questionnaire was used for gathering information on biographical data and family-related information from the elderly participants. This information included gender, age, marital status, number of children, occupation, monthly income, family income, address, basic activities of daily living, assistance devices, and medical history including absence or presence of physical and mental illnesses.

Mini-Mental State Examination (MMSE) Urdu version. Originally developed by Folstein et al. (1975), MMSE measures five areas of cognitive functioning that include orientation, registration, attention and calculation, recall, and language; and is frequently used for screening dementia. The instrument consists of 11 items and was translated and adapted in Urdu by Kausar et al. (2014). It takes about 5-10 minutes to complete. The reliability of MMSE for our sample is .54.

Dementia Rating Scale-2 (DRS-2) Urdu version. The DRS-2 consists of 24 brief subtests combined into five subscales of attention, initiation/perseveration, construction, conceptualization, and memory (Strauss et al., 2006). The composite score of all five subscales equal 144 points and estimates overall dementia (Jurica et al., 2001) and was designed for suspected elderly with dementia that ranged in age between 56-105 years and older. The scale was translated and adapted in Urdu by Kausar et al. (2014). The reliability of the total score of DRS-2 is strong .82 (Jurica et al., 2001) and for our sample .72. This test was administered individually and took 40-60 minutes to complete.

Stroop Neuropsychological Screening Test (SNST) Urdu version. Stroop is a neuropsychological test (Stroop, 1935) used to measure frontal lobe functioning (Demakis, 2004). It consists of Form Color (C) Stimulus Sheet, Form Color-Word (CW) Stimulus Sheet, and Record forms. These forms consist of 112 color names (red, green, blue, yellow) arranged in four columns of 28 names in each stimulus sheet but no color is printed in its color (for example, the word RED might be printed in green, yellow, or blue, but never in red). The participants are instructed to read the words, name the colors, and finally, name the ink color of the printed words as quickly and as accurately as possible in the three subsequent subtasks. There is no time limit to complete a subtask. In the present study, Urdu translated SNST color test and color word test was administered to elders. Both forms consist of 112 names (red, green, blue, and black) arranged in four columns of 28 names in each stimulus sheet but no color is printed in its color). The reliability of Stroop Color Test (SCT) was $\alpha = .73$ and Stroop Color-Word Test (SCWT) was $\alpha = .74$.

Procedure

A cross-sectional research design was used to investigate the neurological functioning of the elderly in two different mountainous areas, Gilgit and Skardu for this study. After obtaining formal permission from the participants who met the inclusion criteria, and were willing to participate, neurological assessment protocols were administered individually. A neuropsychological interview was conducted with the participants before the administration of the tests.

We followed ethical guidelines set by the American Psychological Association for this study and took informed consent from the participants, and told them that information would be used for the research purposes only. We assured them about the confidentiality and anonymity of the data, and that no one would be harmed in the study. Demographic information was obtained first followed by MMSE, DRS-2, and SNST, which were individually administered to each taking about 90 minutes for completion. Since we were aware of test fatigue in the elderly, testing was participant-paced, giving them rest during long sessions. Low scores on all scales and subscales indicated neurological impairments and deficits. A score of 23 or lower on MMSE is indicative of cognitive impairment. Scoring and interpretations were done following the DRS-2 manual. Before the administration of the Urdu version of SNST, participants were asked to name the colors in Stroop Color and Color-Word Stimulus Sheets. There was no time limit to complete these tasks. Few elders had difficulties in naming the ink colors of the printed words for the Stroop color-word test.

Data were analyzed using descriptive and inferential statistics with Statistical Package for Social Sciences (SPSS) 20 version (IBM Corp. Released 2011). Descriptive analyses included frequencies, percentages, parametric chi-square for demographic parameters. Pearson Product Moment Correlation was computed to examine the relationship among mental state, cognitive functioning, and frontal lobe/neurological functioning of elderly men and women. Independent sample *t*-test was computed to compare city and gender differences, and one-way ANOVA analyses were used to compare income and occupational factors followed by post hoc Tukey tests.

Results

Pearson Product Moment Correlation analysis was computed to calculate the relationship on the scores of mental state (MMSE), dementia (DRS-2), and neuropsychological function (SCT and SCWT) test as a function of regional area (Table 2) and gender (Table 3) of elderly participants.

Table 2

Descriptive Statistics and Correlations for Study Variables in regional areas of Gilgit-Baltistan

Variables	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*M*	*SD*
1 MMSE	-	.14	.47**	.46**	.49**	.43**	.65**	.39**	.19	19.9	3.8
2 ATT	.37*	-	.14	.03	.23	.12	.48**	.01	.14	27.4	4.7
3 I/P	.27	.38*	-	.23	.33*	.16	.74**	.34*	.13	21.9	8.2
4 CONST	.05	.17	.23	-	.28*	.34*	.47**	-.02	.32*	3.8	2.3
5 CONCEP	.23	.15	.24	-.03	-	.19	.72**	.31*	-.03	26.5	6.5
6 MEM	.30	.47**	.16	.04	.45**	-	.53**	.48**	.10	13.7	4.8
7 DRS-2	.42**	.71**	.68**	.26	.66**	.70**	-	.43**	.16	93.4	16.6
8 SCT	.16	.43*	.79**	.22	.45*	.55**	.77**	-	-.06	105	16.2
9 SCW	.13	.41	.52*	.28	.26	.49*	.55**	.78**	-	77	26.7
M	22.6	26.6	20	3.9	26	13.9	90.6	86.6	70		
SD	3.4	5.4	6.2	1.7	6.1	4.8	15.8	22.5	31		

Note. Intercorrelations for Gilgit elderly participants (n = 52) are presented above the diagonal, and intercorrelations for Balti elderly participants (n = 39) are presented below the diagonal. Means and standard deviations for

the Gilgit elderly are presented in the vertical columns, and means and standard deviations for the Balti elderly are presented in the horizontal rows. For all scales, higher scores are indicative of more extreme responses in the direction of the construct assessed. MMSE= Mini-Mental Status Examination, ATT= Attention subscale of DRS-2, I/P= Initial Perseveration (I/P) subscale, CONST = Construction subscale of DRS-2, CONCEP = Conceptualization subscale of DRS-2, MEM= Memory subscale of DRS-2, DRS-2 = Dementia Rating Scale, SCT= STROOP Color Test, and SCW= STROOP Color-Word Test; *p<.05, **p< .001.

Table 2 shows a significant positive relationship between mental state and dementia (r = .65, p < .001) and mental state and SCT (r = .39, p < .001) for Gilgit elderly participants. Further, significant positive relationship between dementia and SCT (r = .43, p < .001) measure. Dementia is also significant positively correlated to all subscales of dementia, at level of .001. For Balti elderly participants, a significant (r = .42, p < .001) positive relationship between mental state and dementia was revealed. There is also a significant positive relationship between mental state and attention, subscale of dementia (r = .37, p < .001) for Balti elderly participants. However, there is significant positive relationship of dementia with SCT (r = .77, p < .001) and SCWT (r = .55, p < .001) measures. Dementia is also positively statistically significant related to all subscales of dementia except construction, at level of .001. SCT and SCWT were also positively significantly (r = .78, p = .001) related to one another.

Table 3

Descriptive Statistics and Correlations for Study Variables in gender

Variables	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*M*	*SD*
1 MMSE	-	.27*	.26*	.35**	.19	.43**	.44**	.03	.19	21.8	3.6
2 ATT	.06	-	.28*	.04	.25*	.34**	.64**	.24	.26	26.9	5.4
3 I/P	.45*	.14	-	.21	.42**	.18	.76**	.59**	.29*	21.4	7.4
4 CONST	.41*	.20	.29	-	.16	.19	.34**	.07	.40**	3.69	2.05

5 CONCEP	.65**	.09	.09	.24	-.21	.69**	.32*	.13	26.7	5.6
6 MEM	.31	.03	.11	.36	.53**	-.59**	.32*	.21	13.7	5.1
7 DRS-2	.69**	.42**	.63**	.53**	.73**	.63**	-.55**	.36**	92.4	16.6
8 SCT	.44*	-.09	.31	-.02	.52*	.66**	.53**	-.33*	95.4	25.1
9 SCW	-.03	.14	.16	-.16	-.08	.12	.09	.09	-	64.3	37.3
M	19.3	27.3	20.2	4.2	25.8	14.1	91.8	103	76.5		
SD	3.88	4.15	7.57	1.9	7.7	4.1	15.7	13.6	21.3		

Note. Intercorrelations for elderly male participants (n = 63) are presented above the diagonal, and intercorrelations for elderly female participants (n = 28) are presented below the diagonal. Means and standard deviations for elderly males are presented in the vertical columns, and means and standard deviations for elderly females are presented in the horizontal rows. For all scales, higher scores are indicative of more extreme responses in the direction of the construct assessed. MMSE= Mini-Mental Status Examination, ATT= Attention subscale of DRS-2, I/P= Initial Perseveration (I/P) subscale, CONST = Construction subscale of DRS-2, CONCEP = Conceptualization subscale of DRS-2, MEM= Memory subscale of DRS-2, DRS-2 = Dementia Rating Scale, SCT= STROOP Color Test, and SCW= STROOP Color-Word Test; *p<.05, **p< .001.

Table 3 shows a similar pattern across genders, for elderly men a significant (r = .44, p < .001) positive relationship was revealed between mental state and dementia; and significant positive relationships between dementia and SCT (r = .55, p < .001) and SCWT (r = .36, p < .001) measures. SCT and SCWT were also positively significantly (r = .33, p < .05) related to one another. For elderly women, a significant (r = .69, p < .001) positive relationship was revealed between mental state and dementia; and significant positive relationships between dementia and SCT (r = .53, p < .001) and SCWT (r = .44, p < .001) measures.

Independent sample *t*-tests analyzed differences in MMSE, DRS-2, SCT, and SCWT for areas (Table 4) and gender (Table 5).

Table 4

Mean, Standard Deviation, and independent sample t-test of regional area differences on the neuropsychological measures (N=91)

Variables	Gilgit Elderly *(n=52)*		Balti Elderly *(n=39)*				95% CI		
	M	*SD*	*M*	*SD*	*t(89)*	*p*	LL	UL	*Cohen's d*
MMSE	19.98	3.87	22.59	3.39	3.35	.01	-4.2	-1.1	0.71
ATT	27.42	4.74	26.62	5.41	.76	.45	-1.3	2.9	0.16
I/P	21.98	8.19	19.74	6.15	1.43	.14	-.87	5.4	0.30
CONST	3.88	2.25	3.87	1.70	.030	.97	-.84	.87	0.01
CONCEPT	26.46	6.49	26.38	6.07	.06	.95	-2.6	2.7	0.01
MEM	13.73	4.88	13.95	4.81	.21	.83	-2.3	1.8	0.05
DRS-2	93.48	16.61	90.56	15.84	.85	.40	-3.9	9.7	0.18
SCT	104.9	16.2	83.5	25.9	4.6	.00	9.7	27	0.97
SCWT	74.3	28.7	54.6	39.8	2.3	.03	-7.4	21	0.48

Note. CI = Confidence lnterval; LL = Lower Limit; UL = Upper Limit; MMSE= Mini Mental Status Examination; ATT = Attention; I/P= Initiation/Perseveration; CONST = Construction; CONCEPT = Conceptualization, MEM= Memory; DRS-2= Dementia Rating Scale-2; SCT= STROOP Color Test; and SCWT= STROOP Color-Word Test.

Table 4 shows elderly from Skardu (M = 22.59, SD = 3.39) did significantly ($t(89) = -2.61$, $p < .01$, Cohen's $d = .71$) better on MMSE than elderly from Gilgit (M = 19.98, SD = 3.87). However this was flipped for

SCT and SCWT; elderly from Gilgit (*M* = 104.98, *SD* = 16.23) did significantly (*t*(89) = 4.56, *p* < .001, Cohen's *d* = .97) better on SCT than elderly from Skardu (*M* = 83.46, *SD* = 25.97). Similarly, elderly from Gilgit (*M* = 74.33, *SD* = 28.70) did significantly (*t*(89) = 2.25, *p* < .03, Cohen's *d* = .48) better on SCWT than elderly from Skardu (*M* = 54.62, *SD* = 39.85). Elderly from Gilgit (*M* = 93.48, *SD* = 16.61) score higher on DRS-2 than elderly from Skardu (*M* = 90.56, *SD* = 15.84) however the difference was not significant (*p* > .05).

Table 5

Mean, Standard Deviation, and independent sample t-test of regional area differences on the neuropsychological measures (N=91)

Variables	Female Elderly *(n=28)*		Male Elderly *(n=63)*				95% CI		
	M	*SD*	*M*	*SD*	*t(89)*	*p*	LL	UL	*Cohen's d*
MMSE	19.32	3.88	21.89	3.64	3.05	.00	-4.24	-.89	0.65
ATT	27.32	4.15	26.97	5.39	.31	.75	-1.93	2.63	0.07
I/P	20.29	7.57	21.35	7.41	.63	.53	-4.43	2.30	0.13
CONST	4.29	1.94	3.69	2.05	1.28	.20	-.32	1.49	0.27
CONCEPT	25.86	7.67	26.68	5.61	.57	.56	-3.67	2.02	0.12
MEM	14.11	4.13	13.69	5.13	.37	.71	-1.78	2.59	0.08
DRS-2	91.86	15.67	92.39	16.64	.15	.88	-7.92	6.84	0.03
SCT	102.5	13.66	95.42	25.05	1.27	.21	-4.55	15.61	0.27
SCWT	76.5	21.26	64.34	37.33	1.79	.07	-9.59	18.92	0.38

Note. CI = Confidence lnterval; LL = Lower Limit; UL = Upper Limit; MMSE= Mini Mental Status Examination; ATT = Attention; I/P=

Initiation/Perseveration; CONST = Construction; CONCEPT = Conceptualization, MEM= Memory; DRS-2= Dementia Rating Scale-2; SCT= STROOP Color Test; and SCWT= STROOP Color-Word Test.

Table 5 shows, elderly men (M = 21.89, SD = 3.64) did significantly (t (89) = 3.05, $p < .001$, Cohen's d = .65) better on MMSE than elderly women (M = 19.32, SD = 3.88). Elderly men (M = 92.39, SD = 16.64) scored higher on DRS-2 than elderly women (M = 91.86, SD = 15.67) but this difference was not significant ($p < .05$); but elderly men (M = 95.42, SD = 25.05) scored lower on SCT than elderly women (M = 102.48, SD = 13.66) and this difference was also not significant ($p < .05$). Similarly, elderly men (M = 64.34, SD = 37.33) scored lower on SCWT than elderly women (M = 76.45, SD = 21.26) and the difference was not significant ($p < .05$).

One-way ANOVA was computed to compare elderly' income (Table 6) and occupation differences (Table 7) on the measures. Tukey post hoc analysis was conducted on one-way ANOVA.

Table 6

Mean, Standard Deviation, and One-Way Analyses of Variance of monthly income on neuropsychological measures

Variables	Rs. 10000 & below *(n=56)*		Rs. 10000 – 25000 *(n=15)*		Rs.25000 - 50000 *(n=16)*		Rs. 50000 & above *(n=4)*			
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*
MMSE	20.45	3.7	21.1	4.05	22.6	4.24	24	2.45	2.18	.09
ATT	26.46	4.6	26.1	5.21	29.6	5.45	29	6.38	2.09	.11
I/P	19.98	7.4	19.3	6.32	25.1	7.31	25.5	7.0	2.91	.04
CONST	3.75	2.2	3.4	1.84	4.68	1.54	4.25	2.06	1.27	.29

CONCEPT	25.43	6.1	26.7	4.35	27.5	7.11	35.2	5.68	3.54	.02
MEM	14.07	4.3	11.4	5.33	14.5	5.88	16.5	4.12	1.90	.14
DRS-2	89.69	14.3	86.9	14.3	101.5	18.1	110	20.5	4.98	.00
SCT	98.90	18.9	91.2	26.2	107.6	12.6	96.5	29.7	1.39	.25
SCWT	70.35	29.0	84.2	23.4	87.9	11.3	62	49.6	2.07	.11

Note. CI = Confidence lnterval; LL = Lower Limit; UL = Upper Limit; MMSE= Mini Mental Status Examination; ATT = Attention; I/P= Initiation/Perseveration; CONST = Construction; CONCEPT = Conceptualization, MEM= Memory; DRS-2= Dementia Rating Scale-2; SCT= STROOP Color Test; SCWT= STROOP Color-Word Test.

There was a statistically significant difference between groups as was determined by one-way ANOVA ($F_{3, 87}$= 2.91, *p*= .039). A post hoc test revealed no statistically significant difference between the monthly income groups. The effect of the conceptualization subscale of DRS-2 was significant overall ($F_{3, 87}$= 3.54, *p*= .018). A post hoc test revealed that the significant difference was between the means of elders who earn < 10000 rupees per month (M= 25.43, SD= 6.09) and the elders who earn 50000> rupees (M= 35.25, SD= 5.68) on conceptualization subscale, significant at .014.

Similarly, the effect of DRS-2 was significant overall ($F_{3, 87}$= 4.98, *p*= .003). A post hoc test revealed that the performance of elderly on the Dementia Rating Scale was statistically significantly poor who earned < 10000 rupees per month (M= 89.69, SD= 14.31) and the elders who earn between 25000 and 50000 rupees (M= 101.5, SD= 18.08) compared to the elders earned more than 50000 rupees per month (M=110.5, SD= 20.55), significant at .04. There was no statistically significant difference in the monthly income of the elderly groups on MMSE, SCT, SCWT, and subscales (attention, construction, and memory) of DRS-2.

Table 7

Mean, Standard Deviation, and One-Way Analyses of Variance of the profession on neuropsychological measures

Variables	Farming		Domestic Chores		Small business		Social work		Other work		No work		Both farming & domestic chores			
	(n=30)		*(n=16)*		*(n=11)*		*(n=4)*		*(n=10)*		*(n=14)*		*(n=4)*			
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*P*
MMSE	22	3.3	19	4.2	20	4.0	23	1.9	24	4	18	3.3	22.3	3.8	3.59	.00
ATT	26	5.4	28	3.4	25	4.9	35	2.5	27	4	27	3.7	21.5	7.6	3.50	.00
I/P	20	7.3	20	5.8	23.	8.2	30	6.9	20	6	18	7.3	22.3	11	1.68	.13
CONST	3.6	1.8	4.8	1.7	3.6	2.2	5	1.4	4.9	1.5	2.4	2.3	4.0	2.3	2.95	.01
CONCEPT	26	6.7	28	8.2	27	7.0	31	5.4	24	5.6	26	3.5	23.3	1.3	.82	.56
MEM	13	5.4	14	4.2	12	6.3	15	3.2	14	5.6	14	3.2	15.8	5.4	.48	.83
DRS.2	90	17	96	14	92	16	117	12	90	16	87	10	86.8	17	2.33	.04
SCT	89	22	103	13	103	22	112	1.5	78	40	105	9.2	111	1.5	2.37	.03
SCWT	63	36	80	23	70	33	78	44	63	49	58	32	69.5	13	1.41	.22

The effect of the elder's occupation on cognitive functioning was significant overall on Mini-Mental Status Examination ($F_{6,82}$= 3.59, *p*= .003). A post hoc test revealed that the significant difference was between the means of farming/livestock and the elders who are out of work, significant at .05. Similarly, the significant difference was between the means of the elders who are out of work and the elders who are engaged in other jobs such as (veterans, teachers, etc.) significant at .007. The mean scores of farming/livestock (M= 22.07, SD= 3.27) and other accompanying work (M= 24.00, SD= 3.92) were significantly higher than that for the elders who are out of work (M=18.43, SD=3.28). This indicates that the elderly who are engaged in the different nature of work performed better on Mini-Mental Status Examination as compared to those elders

who don't work or engage in any type of work. The effect of the elder's work on frontal lobe functioning was significant on Stroop Color Test ($F_{6,82}$= 2.37, *p*= .037). A post hoc test revealed that difference was between the means of elderly occupation of Gilgit and Skardu indicating the above-average effect of occupation on elders living but significant differences were not reported.

The effect of the elder's work on overall cognitive functioning was significant overall on Dementia Rating Scale-2 ($F_{6,82}$= 2.33, *p*= .040). A post hoc test revealed that the significant difference was between the means of farming/livestock and social/community workers, significant at .036. Similarly, the significant difference was between the means of social/community workers and the elders who are out of work, significant at .020. The mean scores of social/community workers (M= 117.50, SD= 10.07) and farming/livestock (M= 90.40, SD= 17.75) were significantly higher than that for the elders who are out of work (M=86.93, SD=10.19).

The effect of the attention subscale of DRS-2 was significant overall ($F_{6,82}$= 3.50, *p*= .004). A post hoc test revealed that the significant difference was between the means of elderly social or community work and farming/livestock and between the means of social or community workers and elderly who run a small business, significant at .016 and .014. Similarly, the significant difference was between the means of social/community workers and unemployed elders, significant at .023. The mean scores of elderly' social/community work (M=35.50, SD=2.52) were significantly higher than that for elderly' farming/livestock (M=26.83, SD=5.43), small business (M= 25.91, SD=4.95), and the elders who are out of work (M= 26.57, SD=3.69). However, the mean attention scores of social/community workers (M=35.50, SD=2.52) is significantly higher than that of elders who do both farming and household chores (M= 21.50, SD=7.59) significant at .001 indicating attention deficits in elders who depend on both farming and household chores for their living.

The effect of construction was significant overall ($F_{6,82}$= 2.95, *p*= .012). A post hoc test revealed that the significant difference was between the means of elders who do household chores and the elders who are out of work significant at .015. Similarly, the significant difference was between the means of other work and the elders who are out of work,

significant at .04. The mean construction scores of household chores (M= 4.81, SD=1.68) and other work (M= 4.90, SD= 1.45) were significantly higher than that of elders who are out of work (M=2.36, SD=2.31). Conversely, overall occupation and initiation/ preservation, conceptualization, and memory of elders were not significant which indicates that the nature of occupation does not have a significant effect on the lives of elders.

Discussion

This study assessed the neuropsychological functions of a small group of elderly residing in the mountainous communities of Gilgit and Skardu, Gilgit-Baltistan. Data revealed a significant positive relationship between mental state and dementia; and a significant positive relationship between dementia and neuropsychological functions measured by Stroop tests. Intercorrelation analysis of gender showed a significant positive relationship of mental state with dementia and cognitive functioning among elderly men whereas a significant positive relationship of mental state with dementia and neuropsychological functioning among elderly women was reported. It indicates elderly men and women with cognitive deficits exhibited lower mental state and neuropsychological functioning. Research has demonstrated that cognitive functioning appears to be quite sensitive to changes associated with aging (Van Gorp et al., 1990). Tian et al. (2021) reported that sensorimotor integration, cognitive, and locomotion functioning are impaired among older adults as it is age-related dual decline experiences. Ylikoski (2000) suggested that the average decline in cognitive competence may begin in the mid-fifties, but it is typically of a smaller magnitude until the seventies are reached. Longitudinal studies of aging have shown a decline in memory as well as in intelligence, verbal fluency, and spatial ability (Fozard et al., 1994; Giambra et al., 1995; MacDonald & Christiansen, 2002; Mitrushina & Satz, 1991; Schaie, 1994; Zelinski & Burnight, 1997). Numerous studies have highlighted pronounced age-related decline in visual memory and suggested that older adults have greater difficulty with language tasks that are dependent on working memory such as the production and comprehension of complex grammar or semantically difficult content

(Crook et al., 1992; Janowsky & Thomas-Thrapp, 1993; Kemper & Kemtes, 2002; Kemper & Sumner, 2001; Kemper et al., 2001; Ylikoski, 2000). However, cross-sectional studies have reported impairment in tests that are related to the speed of performance in relation to construction, attention, and psychomotor components (Elias et al., 1993; Howieson et al., 1993; Mazaux et al., 1995).

Mean scores of elderly living in Skardu were significantly higher than that of elderly living in Gilgit indicating cognitive deficits in Gilgiti elders. However, the mean scores on neurological functioning of the Gilgit elderly were significantly higher than that of the elderly of Skardu indicating cognitive deficits in Balti elderly participants. Connors et al. (2013) stated that elderly living in rural areas have a very strong desire to remain connected to their community. Consistent with previous research, this study also demonstrated that the elderly of mountain bounded valleys prefer to be connected with their community. Community cohesion is higher in the countryside areas and close-knit communities in rural areas provide protection against the effects of aging (Heenan, 2010).

Furthermore, elderly women exhibited poor mental state as compared to elderly men on independent sample test analysis. However, elderly men and women scored poorly on overall cognitive functioning depicting cognitive impairment and adequate neurological functioning. Ylikoski (2000) reported no difference in elders of both sexes in terms of their neuropsychological and ability tests. Males performed better on tests related to physical strength and spatial skills, and quantitative skills, whereas women exhibited better performance on tests of verbal abilities and subscales such as fluency or verbal memory tests (Heaton et al., 1986; Mortensen & Gade, 1993).

Elderly participants were earning less than ten thousand rupees per month exhibited odds of increased dementia and poor performance on mental functioning and frontal lobe functioning. Findings, also suggest that elderly who are engaged in farming/livestock, household chores, and community/social work have satisfactory overall cognitive functioning and frontal lobe functioning than those elders who are dependent on others. The findings of this study are linked with the WHO (2015) report that stated that nearly 60% of people with dementia live in low and middle-

income countries. Socioeconomic status has been linked to poorer baseline cognitive test scores and increased risk for dementia (Fischer et al., 2009; Longobardi et al., 2000). It is believed that the elderly living in rural areas have a very strong desire to stay within and connected to their local community (Connors et al., 2013) that can also shape their cultural beliefs and norms.

In line with the opinion of Gilbert (1986) and Luria (1933) as cited by Nell (1999) in his study, the present study observed certain associated cultural features with the different stimuli of neuropsychological instruments that confirmed the orientation and perception of the elderly of mountain bounded valleys. For instance, one of the participants narrated a circle stimulus as a piece of bread (*roti / fitti / kista*). Some related geometric stimuli, such as triangles or diamonds connected with lines, to their farmlands and ranches while elderly women linked different stimuli to their household or other substances. Initially, some elderly participants from Gilgit and Skardu named colors in Shina and Balti languages, for instance, red as '*lalo'*, green as '*neelo'*, black as '*kino'*, blue as '*aagaineelo'* on Stroop color and color word test and associated their life experiences and feasts of harvest with these colors.

Among 91 participants, 31% of elders reported using eyeglasses while 56% were not using any type of assistance devices. Elders may experience declining visual perception or retinal blurring (Artal et al., 1993; Scialfa, 2002; Scialfa et al., 1999) that could have consequences for visual language processing such as a reduction in the speed and accuracy of recognizing words and reading text (Akutsu et al., 1991; Steenbekkers, 1998). Schenker (1996) suggested that hearing loss increases among rural populations particularly elderly farmers but in this study hearing difficulties or impairment did not seem to increase with age in the elderly of Gilgit and Skardu. During various tasks of neuropsychological measures, elderly participants showed poor performance in terms of picture description tasks and sentence production tasks. This finding is consistent with the numerous studies (Altmann, 2004; Kemper et al., 2003; Vesneski et al., 1998).

Limitations and Suggestions

Based on these findings, few suggestions can be made to researchers, cross-cultural psychologists, neuropsychologists, clinical psychologists, community health professionals, and counselors for the elderly population. It is suggested that similar studies can be conducted with larger sample sizes and across diverse groups or populations. It would be pragmatic to consider local and cultural knowledge during the neuropsychological assessment and the examiner must be culturally sensitive. Evidence-based strategies could be designed for the elderly population in order to maximize their quality of life. It is also suggested that brain imaging techniques, such as MRI and PET be carried out to assess the anatomical and functional alterations of the elderly brain in terms of studying cognitive functioning and impairments.

Implications

The findings are expected to have implications for improving the quality of life of the elderly, by designing interventions, support systems, and rehabilitation services to help them. However, findings may attract the attention of policymakers, cross-cultural psychologists, neuro-psychologists, clinical psychologists, community health professionals, counselors, and researchers as currently, this is the most neglected population in Pakistan. It is recommended that future studies can be carried out with the focus of extension or replication in order to provide up-to-date research-based evidence.

Conclusion

This study was aimed to assess the neurological functioning of a subset of the elderly residing within the communities of high altitude regions of Gilgit and Skardu, Gilgit-Baltistan in Pakistan. Findings showed a significant positive relationship between mental state and dementia among elderly participants. However, there was also a significant positive relationship between dementia with neuropsychological functioning. Inter-correlation analysis of gender showed a significant positive relationship of mental state with dementia and cognitive functioning among elderly men whereas a significant positive relationship of mental state with dementia

and neuropsychological functioning among elderly women was reported. It indicates that elderly men and women with cognitive deficits exhibited lower mental state and neuropsychological functioning. In terms of regional differences, elderly living in Skardu were significantly higher in the mental state than that of elderly living in Gilgit indicating cognitive deficits in Gilgiti elders. However, the mean scores on neurological functioning of the Gilgit elderly were significantly higher than that of the elderly of Skardu indicating cognitive deficits in elderly participants of Skardu. Furthermore, as gender differences were analyzed, women exhibited poor mental state as compared to men on independent sample *t*-test analysis. However, both genders scored poorly on overall cognitive functioning but showed adequate neurological functioning. Elderly participants earning less than ten thousand rupees per month exhibited increased dementia and poor performance on mental functioning and frontal lobe functioning. Findings, also suggest that elderly who are engaged in farming/livestock, household chores, and community/social work have satisfactory overall cognitive functioning and neuropsychological functioning than those elders who are dependent on others. Elderly associated certain cultural features with the different stimuli of neuropsychological instruments that confirmed the orientation and perception of the elderly of mountain bounded valleys. Further, hearing difficulties or impairment does not seem to increase with age in the elderly of Gilgit and Skardu.

References

Adamson, M. M., Shakil, S., Sultana, T., Hasan, M. A., Mubarak, F., Enam, S. A., Parvaz, M. A., & Razi, A. (2020). Brain injury and dementia in Pakistan: Current Perspectives. *Frontiers in Neurology*, *11*, 299.

Ahmed, A., Chaudhry, A. G., & Khan, S. (2015). Declining Age and Social Roles: A Gerontological Perspective of Older Persons of Rawalpindi. *Science International*, *27*, 1, 719-721.

Akutsu, H., Legge, G. E., Ross, J. A., & Schuebel, K. J. (1991). Psychophysics of reading—X. Effects of age-related changes in vision. *Journal of Gerontology*, *46*, 6, 325-331.

Ali, S. M., & Kiani, M. F. K. (2003). *Ageing and poverty in Pakistan*. Pakistan Institute of Development Economics.

Almeida, O. P., Hulse, G. K., Lawrence, D., & Flicker, L. (2002). Smoking as a risk factor for Alzheimer's disease: contrasting evidence from a systematic review of case–control and cohort studies. *Addiction*, *97*, 1, 15-28.

Altmann, L. J. (2004). Constrained sentence production in probable Alzheimer disease. *Applied Psycholinguistics*, *25*, 2, 145-173.

Artal, P., Ferro, M., Miranda, I., & Navarro, R. (1993). Effects of aging in retinal image quality. *Journal of the Optical Society of America Association*, *10*, 7, 1656-1662.

Ashiq, U., & Asad, A. Z. (2017). The rising old age problem in Pakistan. *Journal of the Research Society of Pakistan*, *54*, 2, 325- 333.

Baig, L. A., Hasan, Z., & Iliyas, M. (2000). Are the elderly in Pakistan getting their due share in health services? Results from a survey done in the peri-urban communities of Karachi. *The Journal of the Pakistan Medical Association*, *50*, 6, 192-196.

Chaudhry, A. G., Ahmed, A., & Hussain, S. (2014). Health, Marital Status and Mode of Living: An Anthropological Study of Ageing Community in Rawalpindi City. In *Medical Forum Monthly Lahore*, *25*, 5, 46-50.

Connors, C., Kenrick, M., & Bloch, A. (2013). *Rural Aging Research Summary Report of Findings*. Department for Environment Food and Rural Affairs: UK.

Crook, T. H., Youngjohn, J. R., Larrabee, G. J., & Salama, M. (1992). Aging and everyday memory: A cross-cultural study. *Neuropsychology*, *6*, 2, 123-136.

Davranche, K., Casini, L., Arnal, P. J., Rupp, T., Perrey, S., & Verges, S. (2016). Cognitive functions and cerebral oxygenation changes during acute and prolonged hypoxic exposure. *Physiology & Behavior*, *164*, 189-197.

Demakis, G. J. (2004). Frontal lobe damage and tests of executive processing: a meta-analysis of the category test, stroop test, and trail-making test. *Journal of Clinical and Experimental Neuropsychology*, *26*, 3, 441-450.

Dildar, S., & Saeed, Y. (2012). Exploratory study of the nature of violence against elderly in district Gujrat, Pakistan. *Academic Research International*, *2*, 3, 661-669.

Elias, M. F., Robbins, M. A., Walter, L. J., & Schultz, N. R. (1993). The influence of gender and age on Halstead-Reitan neuropsychological test performance. *Journal of Gerontology*, *48*, 6, 278-281.

Fischer, C., Yeung, E., Hansen, T., Gibbons, S., Fornazzari, L., Ringer, L., & Schweizer, T. A. (2009). Impact of socioeconomic status on the prevalence of dementia in an inner city memory disorders clinic. *International Psychogeriatrics*, *21*, 6, 1096-1104.

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). "Mini-mental state": a practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, *12*, 3, 189-198.

Forette, F., Seux, M. L., Staessen, J. A., Thijs, L., Babarskiene, M. R., Babeanu, S. Bossini, A., Fagard, R., Gil-Extremera, B., Laks, T., & Kobalava, Z. (2002). The prevention of dementia with antihypertensive treatment: new evidence from the Systolic Hypertension in Europe (Syst-Eur) study. *Archives of Internal Medicine*, *162*, 18, 2046-2052.

Fozard, J. L., Vercruyssen, M., Reynolds, S. L., Hancock, P. A., & Quilter, R. E. (1994). Age differences and changes in reaction time: the Baltimore Longitudinal Study of Aging. *Journal of Gerontology*, *49*, 4, 179-189.

Ganatra, H. A., Zafar, S. N., Qidwai, W., & Rozi, S. (2008). Prevalence and predictors of depression among an elderly population of Pakistan. *Aging and Mental Health*, *12*, 3, 349-356.

Giambra, L. M., Arenberg, D., Zonderman, A. B., Kawas, C., & Costa, P. T. (1995). Adult life span changes in immediate visual memory and verbal intelligence. *Psychology and Aging*, *10*, 1, 123.

Gilbert, A, J. (1986). *Psychology and Social Change in the Third World: A Cognitive Perspective* (Unpublished doctoral dissertation). University of South Africa, Pretoria, South Africa.

Hamano, T., Onoda, K., Takeda, M., Sundquist, K., Yamaguchi, S., & Nabika, T. (2015). Geographic Elevation and Cognitive Function

among Elderly Residents in Rural Mountainous Areas: Shimane CoHRE Study. *International Journal of Environmental Research and Public Health, 12*, 10, 13365-13371.

Heaton, R. K., Grant, I., & Matthews, C. G. (1986). Differences in neuropsychological test performance associated with age, education, and sex. *Neuropsychological Assessment of Neuropsychiatric Disorders*, *1*, 100-120.

Heenan, D. (2010). Rural Ageing in Northern Ireland: Quality of life amongst older people. *Economic & Social Research Council, 12*, 137-143.

Howieson, D. B., Holm, L. A., Kaye, J. A., Oken, B. S., & Howieson, J. (1993). Neurologic function in the optimally healthy oldest old: Neuropsychological evaluation. *Neurology*, *43*, 10, 1882-1882.

IBM Corp. (2011). *IBM SPSS Statistics for Windows, Version 20.0*. Armonk, NY: IBM Corp.

Irshad, M. K., Chaudhry, A. G., & Afzal, M. I. (2015). A comparative study of economic status and psychological ailments among older persons. *Science International, 27*, 1, 737-740.

Janowsky, J. S., & Thomas-Thrapp, L. J. (1993). Complex figure recall in the elderly: A deficit in memory or constructional strategy?. *Journal of Clinical and Experimental Neuropsychology*, *15*, 2, 159-169.

Jurica, P. J., Leitten, C. L., & Mattis, S. (2001). *Dementia rating Scale-2: DRS-2: Professional Manual*. Psychological Assessment Resources.

Kemper, S., Herman, R., & Lian, C. (2003). Age differences in sentence production. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *58*, 5, 260-268.

Kemper, S., & Kemtes, K. A. (2002). Limitations on syntactic processing. In *Constraints on language: Aging, grammar, and memory* (pp. 79-105). Springer, Boston, MA.

Kemper, S., & Sumner, A. (2001). The structure of verbal abilities in young and older adults. *Psychology and Aging*, *16*, 2, 312.

Kemper, S., Thompson, M., & Marquis, J. (2001). Longitudinal change in language production: Effects of aging and dementia on

grammatical complexity and propositional content. *Psychology and Aging, 16,* 4, 227–239.

Khan, M. B., Kumar, R., Irfan, F. B., Irfan, A. B., & Bari, M. E. (2014). Civilian craniocerebral gunshot injuries in a developing country: presentation, injury characteristics, prognostic indicators, and complications. *World Neurosurgery*, *82*(1-2), 14-19.

Kramer, A. F., Coyne, J. T., & Strayer, D. L. (1993). Cognitive function at high altitude. *Human Factors*, *35*, 2, 329-344.

Lee, S., Kawachi, I., Berkman, L. F., & Grodstein, F. (2003). Education, other socioeconomic indicators, and cognitive function. *American Journal of Epidemiology*, *157*, 8, 712-720.

Lezak M. D., Howieson D. B., & Loring D. W. (2004). *Neuropsychological Assessment* (4th ed.). New York, NY: Oxford University Press

Limmer, M., & Platen, P. (2018). The influence of hypoxia and prolonged exercise on attentional performance at high and extreme altitudes: A pilot study. *PloS One*, *13*, 10, e0205285.

Longobardi, P. G., Cummings, J. L., & Anderson-Hanley, C. (2000). *Multicultural perspectives on the neuropsychological and neuropsychiatric assessment and treatment of the elderly.* In Handbook of Cross-Cultural Neuropsychology (pp. 123-144). Springer, Boston, MA.

Luria, A. R. (1933). The second psychological expedition to Central Asia. *Science, 78,* 191-192.

MacDonald, M. C., & Christiansen, M. H. (2002). Reassessing working memory: Comment on Just and Carpenter (1992) and Waters and Caplan (1996). *Psychological Review*, *109,* 35–54.

Mazaux, J. M., Dartigues, J. F., Letenneur, L., Darriet, D., Wiart, L., Gagnon, M., Commenges, D., & Boller, F. (1995). Visuo-spatial attention and psychomotor performance in elderly community residents: effects of age, gender, and education. *Journal of Clinical Experimental Neuropsychology, 17*, 1, 71-81.

Mitrushina, M., & Satz, P. (1991). Changes in cognitive functioning associated with normal aging. *Archives of Clinical Neuropsychology*, *6*(1-2), 49-60.

Morris, M. C., Evans, D. A., Tangney, C. C., Bienias, J. L., & Wilson, R. S. (2006). Associations of vegetable and fruit consumption with age-related cognitive change. *Neurology*, *67*, 8, 1370-1376.

Mortensen, E. L., & Gade, A. (1993). On the relation between demographic variables and neuropsychological test performance. *Scandinavian Journal of Psychology*, *34*, 4, 305-317.

Najam, N., Kanwal, R. H., Kausar, R., & Fatima, H. (2014). Focus group discussions: exploration of psychological and neurological functioning of elderly in Gilgit & Lahore, Pakistan. *European Scientific Journal ESJ*, *10*, 10, 331-350.

Najam, N., Kausar, R., Kanwal, R. H., Batool, S., & Javed, A. (2015). Psychological and Emotional Functioning of Elderly in Pakistan a Comparison in Punjab and Gilgit-Baltistan. *International Scholarly and Scientific Research & Innovation*, *2*, 5, 337.

Nell, V. (1999). Luria in Uzbekistan: The vicissitudes of cross-cultural neuropsychology. *Neuropsychology review*, *9*, 1, 45-52.

Noor-ul-Ain & Kausar, R. (2012). Age Related Cognitive and Physical Deficits, Social Support, Coping and Quality of Life among Elderly Living in Old Homes (8, pp. 74). Abstract retrieved from Psychological Abstracts, Institute of Applied Psychology, University of Punjab, Lahore.

Noor, A., & Najam, N. (2009). Comparative study of memory deficits in younger and older adults. *Pakistan Journal of Psychological Research*, *24*(3-4), 145-159.

Ochi, G., Kanazawa, Y., Hyodo, K., Suwabe, K., Shimizu, T., Fukuie, T., Byun, K., & Soya, H. (2018). Hypoxia-induced lowered executive function depends on arterial oxygen desaturation. *The Journal of Physiological Sciences*, *68*, 6, 847-853.

O'Connor D. W., Pollitt P. A., Hyde J. B., Fellows J. L., Miller N. D., Brook C. P., Reiss B. B. (1989). The reliability and validity of the Mini-Mental State in a British community survey. *Journal of Psychiatry Research, 23*, 1, 87–96.

Penninx, B. W., Guralnik, J. M., Onder, G., Ferrucci, L., Wallace, R. B., & Pahor, M. (2003). Anemia and decline in physical performance

among older persons. *American Journal of Medicine*, 115, 2, 104-110.

Pun, M., Guadagni, V., Bettauer, K. M., Drogos, L. L., Aitken, J., Hartmann, S. E., Furian, M., Muralt, L., Lichtblau, M., Bader, P. R., Rawling, J. M., Protzner, A. B., Ulrich, S., Bloch, K. E., Giesbrecht, B., & Poulin, M. J. (2018). Effects on cognitive functioning of acute, subacute and repeated exposures to high altitude. *Frontiers in Physiology*, *9*, 1131.

Pun, M., Guadagni, V., Drogos, L. L., Pon, C., Hartmann, S. E., Furian, M., Lichtblau, M., Muralt, L., Bader, P. R., Moraga, F. A., Soza, D., Lopez, I., Rawling, J. M., Ulrich, S., Bloch, K. E., Giesbrecht, B., & Poulin, M. J. (2019). Cognitive Effects of Repeated Acute Exposure to Very High Altitude Among Altitude-Experienced Workers at 5050m. *High Altitude Medicine & Biology*, *20*, 4, 361-374.

Qidwai, W. & Ashfaq, T. (2011). Elderly Patients and Their Health in Pakistan: Current Status, Issues, Challenges and Opportunities. *Journal of Liaquat University of Medical and Health Sciences, 10*, 3, 100-101.

Qiu, C., von Strauss, E., Fastbom, J., Winblad, B., & Fratiglioni, L. (2003). Low blood pressure and risk of dementia in the Kungsholmen project: a 6-year follow-up study. *Archives of Neurology, 60*, 2, 223-228.

Sabzwari, S. R., & Azhar, G. (2011). Ageing in Pakistan—a new challenge. *Ageing International*, *36*, 4, 423-427.

Saleem, T., Khalid, U., & Qidwai, W. (2009). Geriatric patients' expectations of their physicians: findings from a tertiary care hospital in Pakistan. *BMC health services research*, *9*, 1, 205-211.

Schaie, K. W. (1994). The course of adult intellectual development. *American Psychologist*, *49*, 4, 304-313.

Schenker, M. B. (1996). Preventive medicine and health promotion are overdue in the agricultural workplace. *Journal of Public Health Policy, 17*, 3, 275-305.

Scialfa, C. T. (2002). The role of sensory factors in cognitive aging research. *Canadian Journal of Experimental Psychology/Revue canadienne de psychologie expérimentale*, *56*, 3, 153-163.

Scialfa, C. T., Hamaluk, E., Skaloud, P., & Pratt, J. (1999). Age differences in saccadic averaging. *Psychology and Aging*, *14*, 4, 695-699.

Shumaker, S. A., Legault, C., Kuller, L., Rapp, S. R., Thal, L., Lane, D. S., Fillit, H., Stefanick, M. L., Hendrix, S. L., Lewis, C. E., Masaki, K., & Coker, L. H. (2004). Conjugated equine estrogens and incidence of probable dementia and mild cognitive impairment in postmenopausal women: Women's Health Initiative Memory Study. *Journal of American Medical Association, 291*, 24, 2947-2958.

Steenbekkers, L. P. A. (1998). Visual contrast sensitivity. In L. P. A. Steenbekkers & C. E. M. Beijsterveldt (Eds.), *Design-relevant characteristics of ageing users. Backgrounds and guidelines for product innovation* (pp. 131–136). Delft: Delft University Press.

Strauss, E., Sherman, E., & Spreen, O. (2006). *A compendium of neuropsychological tests*. New York: Oxford University Press.

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, *18*, 6, 643-662.

Tian, Q., Studenski, S. A., Montero-Odasso, M., Davatzikos, C., Resnick, S. M., & Ferrucci, L. (2021). Cognitive and neuroimaging profiles of older adults with dual decline in memory and gait speed. *Neurobiology of Aging*, *97*, 49-55.

Tombaugh T. N., McIntyre N. J. (1992). The mini-mental state examination: a comprehensive review. *Journal of American Geriatric Society*, *40*, 9, 922–935.

Van Gorp, W. G., Satz, P., & Mitrushina, M. (1990). Neuropsychological processes associated with normal aging. *Developmental Neuropsychology*, *6*, 4, 279-290.

Van, J. G., & Funderburg, K. (2003). Prevention of nutritional deficiencies in the elderly. *The Journal of the Oklahoma State Medical Association*, *96*, 3, 150-153.

Vesneski, M., Schmitter-Edgecombe, M., & Jones, D. (1998). Aging and word finding: A comparison of discourse and nondiscourse tests. *Archives of Clinical Neuropsychology*, *13*, 1, 46-46.

Vertejee, S. S. & Karamali, N. N (2014). Active ageing in Pakistan: Challenges and opportunities. *The Journal of the Pakistan Medical Association, 64*, 1, 76-78.

World Health Organization. (2015). *Global health estimates 2013: Deaths by cause, age, sex and regional grouping, 2000–2012*. In: World Health Organization, Global health estimates. Geneva: World Health Organization.

Young, R. (2016). Ageing and access in the mountains. *The Medical Journal of Australia, 205*, 11, 512-513.

Ylikoski, R. (2000). The relationship of neuropsychological functioning with demographic characteristics, brain imaging findings, and health in elderly individuals (Doctoral dissertation). University of Helsinki, Finland.

Zelinski, E. M., & Burnight, K. P. (1997). Sixteen-year longitudinal and time lag changes in memory and cognition in older adults. *Psychology and Aging*, *12*, 3, 503-513.

Received March 10, 2021
Revisions Received June 28, 2021