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Comparative Cognitive Performance of 60-Year-Old Asian and Western Pilots on the CogScreen Test: A Cross-Sectional Study

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Abstract:- The study aimed to investigate the cognitive performance of the aged 60 and above with different ethnicity (Asian and Western pilots) on the CogScreen test particularly focusing on deductive reasoning and motor speed. A quantitative research approach was used . The current study utilized the cross-sectional approach and data was collected at point of time. The sample size consisted of 100 active pilots aged group 60 from each ethnicity group. The CogScreen test was used to assess cognitive functions. The statistical analyses were conducted by calculating t-tests and regression to compare performance between the two groups. The overall results showed a significant difference in deductive reasoning between Asian and Western pilots which can be seen from the T score (t = -2.77, p = 0.0076). The results showed that western pilots performed better on deductive reasoning as compared to Asian pilots. However, no significant difference was found in motor speed between the two groups (t = -1.60, p = 0.116). These findings suggest that while ethnicity may influence certain cognitive abilities in older pilots, it may not impact others. Overall , both grouped preformed below the expected range as per cog-screen standardized norms on both tasks regardless of their ethnicity. The current study's limitations include a narrow focus on two cognitive abilities and the use of a single assessment tool. However , the future research should consider a broader range of cognitive assessments and factors influencing pilot performance to provide a more comprehensive understanding.

Keywords:- *Cognitive Performance, CogScreen Test, Deductive Reasoning, Motor Speed, Pilot Age, Ethnicity.*

I. INTRODUCTION

➢ *Research Background*

Cognitive function is a refers to mental processes involved in the acquisition of knowledge and used of reasoning ability . Cognitive functions consist of perception, memory, learning, attention, decision making, and language abilities. Safely on board is first priority of airline industry which depend upon pilots' cognitive functions. However , as age changes pilots physical and mental abilities also changes which impact on their performance and flight safety .The CogScreen test has emerged as a useful tool for assessing cognitive functions of the pilots. It provides insights into various cognitive domains, including deductive reasoning and motor speed, which are crucial for safe and efficient flight operations. Previous research has demonstrated the validity of the CogScreen test in assessing cognitive skills in pilots. However , to determine the cog screen effectiveness in assess the senior flying population cognitive functions is still unexplored areas particularly in the Middle Eastern aviation population.

This study aims to fill this gap by examining the performance of pilots aged 60 and above from different ethnicities on the CogScreen test' specific measures of deductive reasoning and motor speed. By doing so, researcher seek to contribute to a better understanding of cognitive performance in older pilots within this specific demographic context.

➢ *Problem Statement*

The absence of research data on the standardization of cog screen for 60-year-old pilots from diverse ethnic backgrounds raises concerns about the validity and reliability of the tool potentially impacting aviation safety and pilot well-being.

- *Research Question:*

Is there a significant difference in the performance of 60-yeara and above Asian and Western pilots on the CogScreen test, particularly in deductive reasoning and motor speed?

➢ *Objectives:*

- To compare the performance of 60-year-old Asian and Western pilots on the CogScreen test in deductive reasoning and motor speed.
- To determine if there are significant differences between the two groups

II. LITERATURE REVIEW

Research on the CogScreen test has revealed consistent differences in cognitive performance between pilot training candidates and commercial pilots (Callister, 1996).The CogScreen test has been found to be a valid measure of cognitive skills relevant to piloting (Taylor, 2000). Research has consistently shown ethnic differences in cognitive performance, with some studies suggesting that these differences are better predicted by cultural complexity than cognitive complexity (Helms-Lorenz, 2000).

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In a study of older adults, African Americans scored lower on cognitive tests compared to Japanese Americans and Caucasians, with education playing a role in modifying this association (Shadlen, 2001). These outcomes indicate that while there may be differences in cognitive performance on the CogScreen test, these differences are not necessarily revealing of inherent abilities. Moreover , Verde (2013) found that gender differences in mental rotation ability were absent in pilots highlight the fact that that experience may play a role in mitigating these differences. However, Berry (2011) reported lower criterion-related validity of cognitive ability tests for Black and Hispanic individuals compared to White individuals which indicate potential ethnic disparities. Hardy (2007) identified a gradual decline in pilot cognition with age with most performance outliers occurring in pilots over 40 years old.

The ethnic differences in cognitive performance with minority groups often scoring lower than the majority group (Oostrom, 2014; Berry, 2011) are indicated by varies researches . These differences are influenced by various factors such as interpretation of test items, verbal ability, and self-serving attributions (Oostrom, 2014, 2016).

However, there are discrepancies in baseline cognition the rate of cognitive decline does not vary significantly by race (Castora-Binkley, 2015). These findings show that although there are ethnic differences in cognitive performance, they are not certainly indicative of long-term cognitive abilities.

Addtionally, Castora-Binkley (2015) found significant differences in baseline cognition but no variation in the rate of cognitive decline by race or ethnicity. These studies collectively indicate that whereas gender differences may be mitigated by experience, there may be ethnic disparities in cognitive performance, and age-related decline is a factor to consider. Nevertheless, the CogScreen-AE, a tool used to assess cognitive function in pilots has been found to be consistent in performance pre- and post-flight (Chee, 2021). Moreover , racial and ethnic differences in cognitive health appraisals have been observed, different race groups such as non-Hispanic Black individuals showed a weaker association between cognitive performance and health appraisals compared to non-Hispanic Whites (Jang, 2021).

It is also worth mentioning that several additional variables influencing cognitive performance in private pilots have been identified by various studies. These variables include age, mental workload, and flight experience, with older age groups showing impaired performance in certain tasks (Causse, 2019). Despite these differences, cognitive test results have been found to be robust indicators of brain health in diverse older adults, regardless of race or ethnicity (saucedo, 2021).

However, There is no research has been conducted on the pilot's ability on specific tasks which have been measure by cog screen such as deductive reason and motor speed and how different ethnicity and age groups preformed on these specific measures. Our current study is based on observational trends among the 60 and above pilots from different ethnicities performance on the deductive reasoning and motor speed. The aim of study is to assess if the cog screen is effective tools for assessing the motor speed and deductive reasoning among the pilots aged group 60 and above . Additionally , it aim how different ethnicities of the same age group perform on these two specific measures especially in the context of the UAE and the broader Middle Eastern aviation population.

III. METHODOLOGY

In the methodology chapter, we will discuss the research design, participants, data collection tool, procedure, and statistical analysis used in the study.

➢ *Null Hypothesis (H0): Null Hypothesis (H0):*

There is no significant difference in the performance of 60-year-old Asian and Western pilots on the CogScreen test in deductive reasoning and motor speed**.**

➢ *Alternative Hypothesis (H1):*

There is a significant difference in the performance of 60-year-old Asian and Western pilots on the CogScreen test in deductive reasoning and motor speed.

➢ *Variables:*

- Independent Variable: Ethnicity (Asian, Western)
- Dependent Variables: CogScreen test scores (deductive reasoning, motor speed)

➢ *Research Design:*

To explore the performance of pilots aged 60 and above from different ethnicities on the Cog Screen test' specific measures of deductive reasoning and motor speed a quantitative cross-sectional research approach was employed. The study exclusively targeted pilots, comprising 100 individuals with an equal representation from each ethnicity group including Asian and Western population groups.

➢ *Participants:*

100 pilots above age 60 from the different airlines UAE aviation industry were part of this research. Convenient sampling was employed to choose participants across all ethnic groups.

➢ *Data Collection Tool:*

To determine the pilot's performance on deductive reasoning , researcher used cog screen test. This instrument is a standardized neurocognitive tool for pilot population to assess the different area of cognitive functions.

➢ *Procedure:*

Professional psychologists trained in the administration of the Cog screen conducted the test and collect data collection. Participants were briefed about the study's purpose and provided with instructions on how to complete the inventory. Test results were online generated .

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IV. STATISTICAL ANALYSIS

- Independent samples t-test to compare mean Cog Screen test scores between Asian and Western pilots for deductive reasoning and motor speed.
- Multiple regression analysis to examine the relationship between independent variables (ethnicity, age,.) and dependent variables (Cog Screen scores).

➢ *Statistics Analysis*

Table 1 Paired Sample Means of Deductive Reasoning for Asian & Western Pilots

T-Test: Paired Two Sample For Means		
	30.67	34.6
Mean	32.968	37.60036364
Variance	78.2636237	98.50518875
Observations	55	55
Pearson Correlation	0.13137305	
Hypothesized Mean Difference	0	
df	54	
t Stat	-2.771077031	
P(T<=t) one-tail	0.00382365	
t Critical one-tail	1.673564906	
P(T<=t) two-tail	0.0076473	
t Critical two-tail	2.004879288	

The table is related to the paired sample means for deductive reasoning . The paired sample means show that Western pilots scored higher (37.60) on deductive reasoning as compare to Asian pilots (32.97). The t-test results indicate a statistically significant difference between the mean of two groups with a t-statistic of -2.77 and a p-value of 0.0076. This suggests that there is a significant difference in deductive reasoning performance between Asian and Western pilots aged over 60. The results shows that Western pilots performed better on average as compared to Asian pilots .However , both grouped scored were below the cog screen standardized Norms.

Table 2 Paired Sample Mean for Motor Speed of the Asian & Western Pilots

T-Test: Paired Two Sample for Means		
	60.56	70.97
Mean	59.05163636	61.856
Variance	76.41714357	141.9723726
Observations	55	55
Pearson Correlation	0.232576193	
Hypothesized Mean Difference	0	
df	54	
t Stat	-1.595395309	
P(T<=t) one-tail	0.05823023	
t Critical one-tail	1.673564906	
P(T<=t) two-tail	0.116460461	
t Critical two-tail	2.004879288	

The table above is explaining the paired sample t mean for motor speed among the western and Asian population. The paired sample means for motor speed show that Asian pilots had a mean score of 59.05, while Western pilots had a mean score of 61.86. The Pearson correlation coefficient of 0.233 indicates a weak positive relationship between the two sets of scores.

The t-test results suggest that the mean difference in motor speed scores between Asian and Western pilots is not statistically significant. The t-statistic of -1.595 is lower than the critical t-value for a two-tailed test at the 0.05 significance level (2.005), with a p-value of 0.116. This suggests that there is no significant difference in motor speed scores between Asian and Western pilots aged over 60. Both grouped equally preformed below average as per cog screen standardized norms.

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Table 3 Regression Statistics of Both Variables (Ethnicity &Cognitive Functions)

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.13137305
R Square	0.017258878
Adjusted R Square	-0.001283407
Standard Error	8.852348151
Observations	55

The table above is corresponding to regression analysis of deductive reasoning among the pilots .These results indicate a weak positive relationship between the predictor variable (deductive reasoning) and the outcome variable.

The value of MR is 0.131 which suggests a weak correlation between deductive reasoning and pilot's ethnicity . The standard error of 8.85 indicates the average distance that the observed values fall from the regression line. Overall, the model does not provide a strong fit for predicting outcomes based on deductive reasoning.

V. CONCLUSION & LIMITATION

The overall statistical analysis revealed that there is a significant difference in deductive reasoning performance between 60-year-old Asian and Western pilots supporting the alternative hypothesis. However, no significant difference was found in motor speed. Therefore, while the hypothesis regarding deductive reasoning is accepted, the one regarding motor speed is not fully supported.

- *Limitation*

Although research covered the required areas and sample size is reasonable for study . Limitations of the current study include the focus on only two cognitive abilities, deductive reasoning and motor speed, which may not fully represent the range of cognitive skills relevant to pilot performance. Additionally, the study's reliance on a single assessment tool, the Cog Screen test may not capture the complexity of pilots' cognitive abilities.

In future research, the aforementioned limitation could be tackled by employing diverse assessments to evaluate identical cognitive abilities. This approach can potentially uncover additional factors that impact pilot performance in specific age groups.

A greater comprehension of pilots' cognitive abilities and the consequent effects on aviation safety could be attained through this.

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APPENDIX

Test Results
CogScreen-Aeromedical Edition

Demographics

NAME :		TEST DATE :	
DATE OF BIRTH :		SESSION NUMBER :	J.M
AGE:	60	EXAMINER'S INITIALS:	
SEX:	Male	HAND PREFERENCE :	Right
RACE :	Caucasian	OPTIONAL ID :	
YEARS OF EDUCATION :	15		
CURRENT OCCUPATION :	Airline Pilot		

Aviator Information

Actively Flying :	Y
Airline :	
Current Aircraft :	Boeing777
Rating :	Captain
Total Flight Hours Logged :	20000
Pilot License Type :	ATP
Medical Certificate Class :	1
Special Medical Issuance :	No
Reason for Special Medical Issuance :	

Reason for Aviation Related Referral

Referral Source :	Airline		
Initial Medical Certification :		Problem Upgrading :	
Medical Re-Certification :		Other Aviation Related :	Y
Proficiency Check :		Selection :	
Transition Training :			

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LRPV SCORE

Logistic Regression Estimated Probability of Brain Dysfunction.

The following probability score (range 0 - 1.0) was generated using a model derived from a forward step-wise likelihood-ratio logistic regression analysis. *A higher LRPV score indicates a higher probability of brain dysfunction.* The LRPV score is for classification estimates only. Note that LRPV is significantly correlated with age and does not predict the magnitude or severity of dysfunction.

LRPV = 0.9997

BASE RATE ANALYSIS

Determines the number of scores falling at or below the 5th percentile and 15th percentile compared to a selected normative comparison group:

	Number of scores at or below 5th percentile	Percentile	T-Score
Speed	3	10	37
Accuracy	3	7.5	35
Thruput	4	5	34
Process	2	10	37

	Number of scores at or below 15th percentile	Percentile	T-Score
Speed	9	7.5	35
Accuracy	5	10	37
Thruput	8	7.5	35
Process	2	50	50

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TAYLOR AVIATION FACTOR SCORES

Factor	Description	Z-Score	T-Score
Attribute Identification	Measure of deductive reasoning.	-1.68	33.21
Motor Coordination	Measure of motor coordination under speeded conditions.	-2.79	77.92
Visual Association Memory	Measure of visual learning and recall.	-1.11	38.87
Speed/Working Memory	Measure of visual scanning, perceptual speed, and working memory.	-0.92	40
Tracking	Measure of visual/psychomotor tracking accuracy.	-0.85	5