IJSRM
INTERNATIONAL JOURNAL OF SCIENCE AND RESEARCH METHODOLOGY
An Official Publication of Human Journals

Human Journals
Research Article
January 2021 Vol.:17, Issue:3

Relationships between Performances IQ, Full Scale IQ, Verbal IQ with Physical Characteristics

IJSRM
INTERNATIONAL JOURNAL OF SCIENCE AND RESEARCH METHODOLOGY
An Official Publication of Human Journals

Mahashweta Das*[1], Prabir Chakraborty[2]

[1] *Department of History, Rabindra Bharati University, Kolkata-700050, West Bengal, India*

[2] *Departmkent of Political Science, Govt. Degree College Gandacherra, Dhalai, Tripura, India*

Submitted: 05 December 2020
Revised: 25 December 2020
Accepted: 16 January 2021

HUMAN JOURNALS

www.ijsrm.humanjournals.com

Keywords: Brain Size; Full Scale IQ; Gamma Models; Joint Generalized Linear Models (Jglms); Performance IQ; Verbal IQ.

ABSTRACT

It is recognized that physical characteristics such as gender, weight, height, Body Mass Index (BMI) and brain size are associated with the Full Scale Intelligence Quotient (FSIQ), Performance IQ (PIQ) and Verbal IQ (VIQ) scores. Earlier studies could not give any clear picture about these relationships with suitable justifications. The current report focuses on the relationships between FSIQ and physical characteristics, and similarly for PIQ and VIQ with physical characteristics based on probabilistic models and model diagnostic checking. It is shown herein that mean FSIQ, or VIQ, or PIQ is directly associated with the full brain size (P<0.01). Mean PIQ, or VIQ is inversely associated with height along with P-values (P=0.01) and (P<0.01), respectively, while mean FSIQ is directly partially associated with height (P=0.08), but it is inversely associated with the joint interaction effect of height and weight (Height*Weight) (P=0.02), and it is directly associated with weight (P=0.02). Furthermore, mean VIQ is inversely associated with gender (P=0.01). Variance of PIQ, or FSIQ, or VIQ is inversely associated with the full brain size along with the P-values (P=0.09), (P=0.01) and (P=0.07), respectively. PIQ, or VIQ, or FSIQ is higher for the subjects with larger full brain size, and PIQ or VIQ is higher for the subjects with shorter height, while FSIQ is higher for the subjects with jointly the lower effect of body weight and height.

INTRODUCTION

Generally, in intelligence literature, three types of IQ such as full scale, performance and verbal IQs are examined frequently for an individual. In the whole 19th and early 20th centuries, the connection between the overall brain size and General Mental Ability (GMA) was adopted universally (Morton, 1849; Broca, 1873; Darwin, 1871; Topinard, 1878). A clear illustration regarding the connection between GMA and brain size was given in the review reports by Rushton and Ankney (1995, 1996, 2007, 2009). The above articles reported most of the important outcomes regarding the relationships of IQs with anatomical characters. The famed neurologist Paul Broca (1824–1880) computed internal and external skull amounts for many individuals, and the researcher concluded that mature adults averaged a greater brain size than either the children, or elderly, famed persons averaged a greater brain size than the less famed, and proficient workers averaged a greater brain size than the less proficient (Broca, 1873). Charles Darwin (1871) noted Broca's outcomes in his book entitled- *The Descent of Man* to confirm the researcher's evolution theory.

The famed Professor Francis Galton (1888), first ascertained the connection between the complete brain size and GMA in living persons and confirmed that men who adopted high honors degrees had a complete brain size approximately 2%–5% greater than those who did not. Galton's data was statistically computed by Professor Karl Pearson (1906) based on correlation coefficient (r), the value of r between complete brain size and GMA is r = 0.11 that is statistically insignificant. So, Galton's study was partially proved by Karl Pearson's correlation analysis. Spearman (1904, 1927) collected the diverse GMA items and noted positive correlation of each subset and a general factor of IQ. National Collaborative Perinatal Project (Broman *et al.* 1975, 1987) data were reported differently by gender, and the correlation for body size was not incorporated. Rushton and Ankney (2009) studied the findings of 28 separate surveys, which accepted brain imaging techniques such as Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) in a total of 1,389 normal persons. The correlation (r) values between the brain size and GMA lie in the range from 0.04 to 0.69.

Mean brain size variety due to gender variety was not accounted for in Broca's study (1873). However, it is often demanded that the gender variety vanishes when corrections are accounted for body size, or for age of surveyed subjects (Gould, 1996). But Ankney (1992) illustrated that the sex variety in brain size remains even after corrections for body size in the uniform aged men and women. Ankney's (1992) findings were approved by Gur *et al.* (1991) and Willerman *et al.* (1991). Rushton and Ankney (2009) concluded that full brain size is directly correlated with IQ, while full brain size and GMA are correlated with age, socioeconomic position, gender, and population group varieties. IQ data sets are multivariate structures, therefore, simple correlations do not approve cause and effect, but multivariate partial nonzero correlations do provide support. Most of the prior reports on IQ studies are founded on simple correlation and ordinary multiple regression analysis which invites ambiguity and controversy. Furthermore, IQ data sets are physiological, which are heteroscedastic in nature, therefore, ordinary multiple regression analysis is inappropriate. Recently, an article by Das and Ghosh (2020) has shown that IQ data sets are heteroscedastic and ordinary multiple regression analysis provides misleading results. The present article is arranged as follows. The following section presents materials & methods, and the subsequent sections present respectively statistical analysis & results, discussion, and followed by conclusions.

MATERIALS AND METHODS

Materials

Willerman *et al.* (1991) investigated IQ of 40 psychology students at a large Southwestern University, who had indicated no history of alcoholism, unconsciousness, brain damage, heart disease, or epilepsy. The data collection procedures and the sample unit descriptions are neatly illustrated by Willerman *et al.* (1991). The selected study units had total scholastic aptitude test scores under 940, or above 1350. These study units had adopted to maintain a course requirement by adjusting the administration of four sub trails namely, Similarities, Picture Completion, Block Design, and Vocabulary of the Wechsler (1981) Adult Intelligence Scale-Revised. The investigated students were equally classed by IQ division and gender.

Willerman *et al.* (1991) studied 7 characters such as height, weight, gender (male=1, female=2), brain size measured by total pixel count from the 18 MRI scans, and the IQ scores based on the four Wechsler (1981) sub trails of FSIQ, VIQ, and PIQ. From the data, one more new variable known as body mass index (BMI) is considered, where BMI is defined as Weight(kg) /

Height(m^2). The data set is listed by Willerman *et al.* (1991), and for ready reference, it is displayed in the Appendix.

Statistical methods

Das and Ghosh (2020) have shown that the current IQ data set is heteroscedastic, so the researchers used Joint Generalized Linear Models (JGLMs) for its analysis. For heteroscedastic data, variance is not stabilized frequently adopting transformation (Myers *et al.* 2002). Note that a positive continuous homogeneous random variable can be modeled either by a gamma, or lognormal model (Firth, 1988), while for an unequal variance random variable, modeling is done using JGLMs under both gamma or lognormal distributions (Das and Lee 2009; Lee *et al.* 2017). JGLMs is well described in the book by Lee *et al.* (2017). In the current article, the three responses PIQ, FSIQ and VIQ are modeled by joint gamma model which is very shortly reported herein. Interested readers can find it elaborately in the book by Lee *et al.* (2017).

JGL Gamma Models: Here PIQ, or FSIQ, or VIQ $= y_i$ say, is the intended positive and continuous random response variables with unequal variance (σ_i^2), and mean $\mu_i = E(y_i)$, keeping relation $Var(y_i) = \sigma_i^2 \mu_i^2 = \sigma_i^2 V(\mu_i)$ say, and the variance has two parts namely, σ_i^2 (free of mean variation) and $V(\mu_i)$ (depends on mean variation), where *V*(.) is termed as variance function, which recognizes the GLM family distribution. As an example, if $V(\mu)=\mu$, it is Poisson, and it is Normal, or gamma if $V(\mu)=1$, or $V(\mu)=\mu^2$, etc. Joint mean and dispersion JGLMs for PIQ, or FSIQ, or VIQ under gamma distribution are given by

$$\eta_i = g(\mu_i) = x_i^t \beta \text{ and } \varepsilon_i = h(\sigma_i^2) = w_i^t \gamma,$$

where $g(\cdot)$ & $h(\cdot)$ are the GLM link functions connected with the mean and dispersion linear predictors respectively, and x_i^t, w_i^t are the vectors of independent explanatory variables connected with the mean and dispersion parameters respectively. Maximum likelihood (ML) method is applied to estimate mean parameters, while the restricted ML (REML) method is adopted to estimate dispersion parameters (Lee *et al.* 2017).

STATISTICAL ANALYSIS & RESULTS

Statistical analysis

The response PIQ, or FSIQ, or VIQ is modeled by JGL gamma models. Here PIQ, or FSIQ, or VIQ is treated as the response, and the physical characters namely, gender, height, weight, BMI and brain size are taken as independent variables. Das and Ghosh (2020) have shown that PIQ is heteroscedastic, and similarly, it is examined herein that FSIQ and VIQ are heteroscedastic random variables. Therefore, three separate JGL gamma models for PIQ, or FSIQ, or VIQ have been derived, and the best model is taken based on the lowest Akaike Information Criterion (AIC) value that minimizes both the squared error loss and predicted additive errors (Hastie *et al.* 2009, p. 203-204). These three best fitted JGL gamma models for PIQ, or FSIQ, or VIQ are displayed in Table 1.

Table No. 1: Final joint gamma model fitting of PIQ, FSIQ and VIQ on physical characters

Model	Covariate	Performance IQ fit				Full scale IQ fit				Verbal IQ fit			
		Estimate	**s.e.**	**t-value**	**P-value**	**Estimate**	**s.e.**	**t-value**	**P-value**	**Estimate**	**s.e.**	**t-value**	**P-value**
Mean	Constant	4.78	0.47	10.17	<0.01	-1.39	2.68	-0.52	0.61	6.79	0.64	10.62	<0.01
	Brain size	0.02	0.01	4.09	<0.01	0.01	<0.00	4.21	<0.01	0.01	<0.00	3.66	<0.01
	Height	-0.02	0.01	-3.03	0.01	0.07	0.04	1.82	0.08	-0.05	0.01	-5.85	<0.01
	Weight	….	….	….	….	0.04	0.02	2.40	0.02	….	….	…	….
	Height*Weight	…..	….	….	…	-0.01	<0.00	-2.49	0.02	…..	…….	….	…..
	Gender	…..	…..	….	……	…..	….	….	…	-0.20	0.08	-2.67	0.01
Dispersion	Constant	1.58	2.92	0.54	0.60	11.48	5.31	2.16	0.04	10.78	7.60	1.42	0.17
	Brain size	-0.06	0.03	-1.74	0.09	-0.01	<0.01	-2.87	0.01	-0.01	<0.01	-1..88	0.07
	Gender	…..	……	….	….	-0.67	0.62	-1.09	0.28	-0.77	0.68	-1.13	0.27
AIC		**328.44**				**325.66**				**328.55**			

The derived JGL gamma PIQ, or FSIQ, or VIQ (Table 1) probabilistic models are data generated models, which are examined by model diagnostic tools in Figure 1, or Figure 2, or Figure 3. Figure 1(a) reveals the PIQ joint gamma fitted absolute residuals plot against the fitted values, which is almost a flat straight line, implying that variance is equal to the running means. Figure 1(b) shows the PIQ joint gamma fitted mean model normal probability plot (Table 1) that does not reveal any lack of fit. So, Figure 1 does not exhibit any lack of PIQ fit (Table 1), implying that the joint gamma fitted PIQ model (Table 1) is approximate of the unknown PIQ's true model.

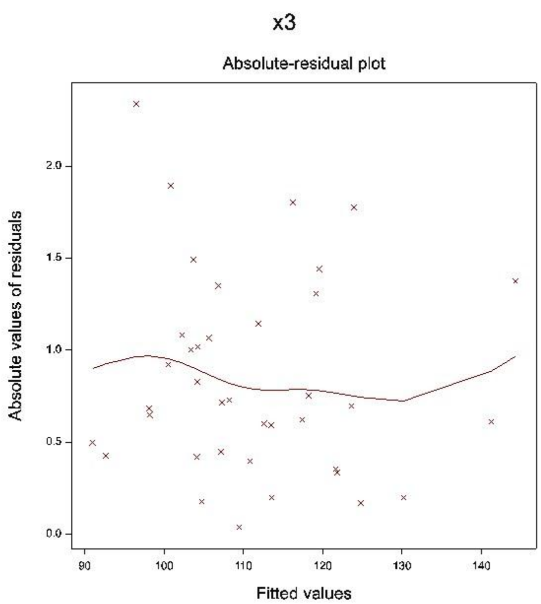


Figure No. 1(a)

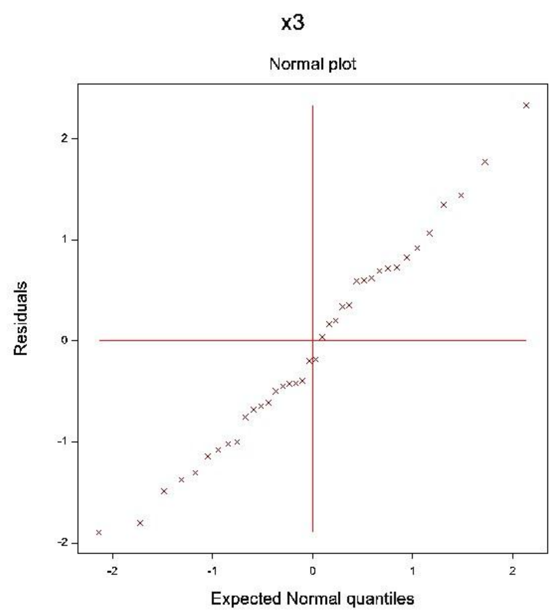


Figure No. 1(b)

Figure No. 1: For the JGL gamma fitted PIQ models (Table 1), the (a) absolute student residuals plot with respect to the fitted values, and (b) the normal probability plot for the mean model.

Figure 2(a) reveals the FSIQ joint gamma fitted absolute residuals plot against the fitted values, whose middle part is exactly a flat straight line, while its two tails are decreasing as the two smaller residuals are located at the left and right boundaries, implying that variance is equal to the running means. Figure 2(b) shows the FSIQ joint gamma fitted mean model normal probability plot (Table 1) that does not reveal any lack of fit. So, Figure 2 does not exhibit any lack of FSIQ fit (Table 1), implying that the joint gamma fitted FSIQ model (Table 1) is approximate of the unknown FSIQ's true model.

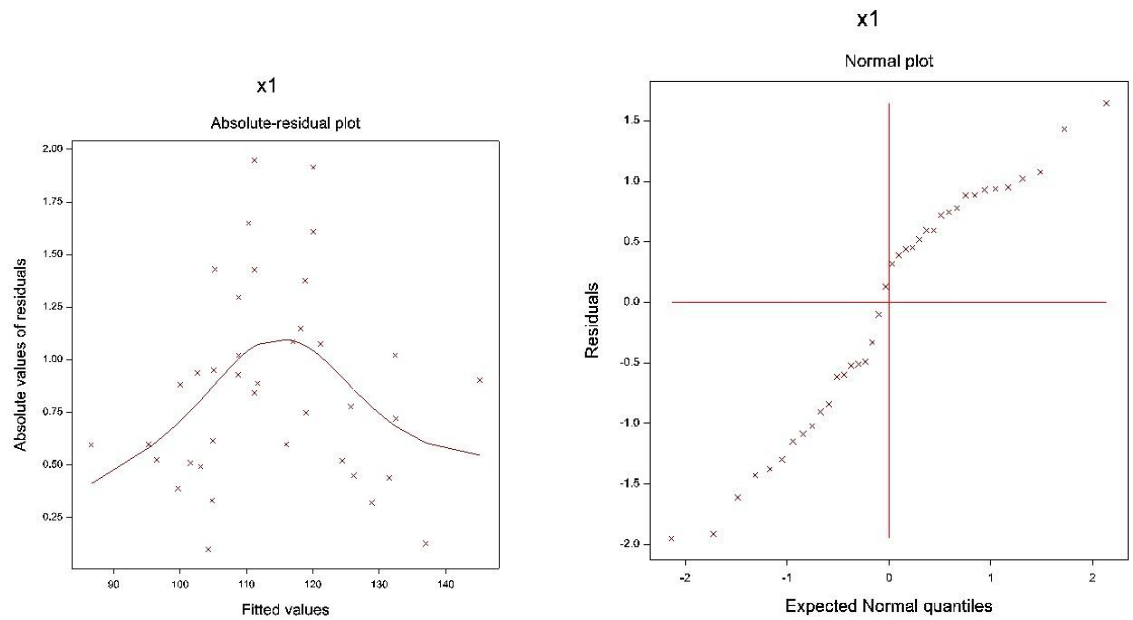
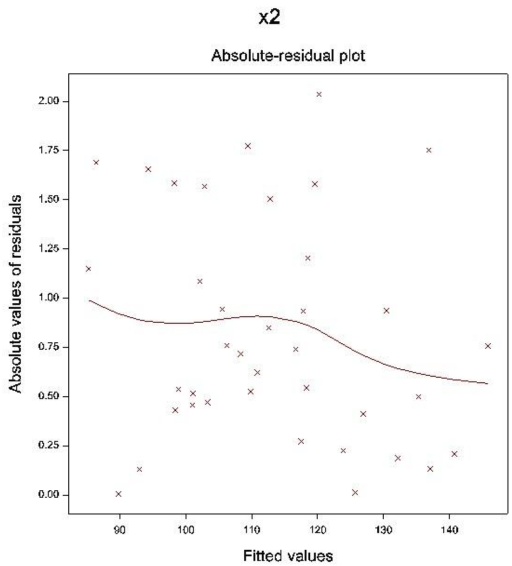


Figure No. 2(a) **Figure No. 2(b)**

Figure No. 2: For the JGL gamma fitted FSIQ models (Table 1), the (a) absolute student residuals plot with respect to the fitted values, and (b) the normal probability plot for the mean model.

Figure 3(a) reveals the VIQ joint gamma fitted absolute residuals plot against the fitted values, which is almost a flat straight line, while its right tail is decreasing as a smaller residual is located at the right boundary, implying that variance is equal to the running means. Figure 3(b) shows the FSIQ joint gamma fitted mean model normal probability plot (Table 1) that does not reveal any lack of fit. So, Figure 3 does not exhibit any lack of VIQ fit (Table 1), implying that the joint gamma fitted VIQ model (Table 1) is approximate of the unknown VIQ's true model.



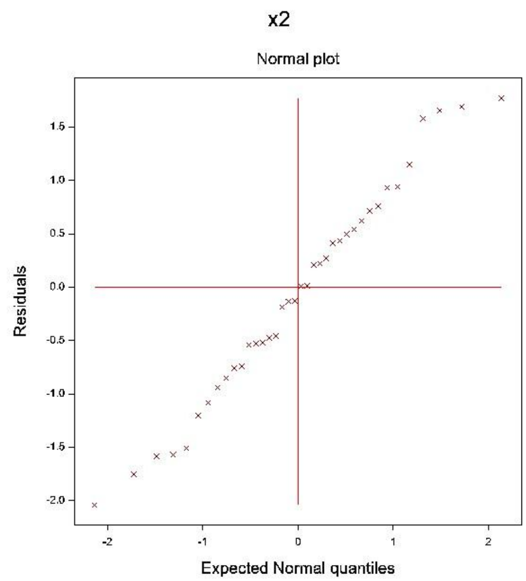


Figure No. 3(a) **Figure No. 3(b)**

Figure No. 3: For the JGL gamma fitted VIQ models (Table 1), the (a) absolute student residuals plot with respect to the fitted values, and (b) the normal probability plot for the mean model.

RESULTS

PIQ Results: Table 1 shows that mean PIQ is directly associated with the full brain size (P<0.01), while it is inversely associated with height (P=0.01). Variance of PIQ is inversely partially associated with the full brain size (P=0.09).

JGL gamma fitted PIQ mean ($\hat{\mu}$) model (Table 1) is

$$\hat{\mu} = \text{exp.}(4.78 + 0.02 \text{ Brain size} -- 0.02 \text{ Height}),$$

and the JGL gamma fitted PIQ dispersion ($\hat{\sigma}^2$) model is

$$\hat{\sigma}^2 = \text{exp.}(1.58 - 0.06 \text{ Brain size}).$$

FSIQ Results: Table 1 shows that mean FSIQ is directly associated with the full brain size (P<0.01), weight (P=0.02) and partially associated with height (P=0.08), while it is inversely associated with the joint interaction effect of height and weight (Height*Weight) (P=0.02). Variance of FSIQ is inversely associated with the full brain size (P=0.01). In the FSIQ variance model, an insignificant effect gender is included for better fitting.

JGL gamma fitted FSIQ mean ($\hat{\mu}$) model (Table 1) is

$$\hat{\mu} = \text{exp.}(-1.39 + 0.01 \text{ Brain size} + 0.07 \text{ Height} + 0.04 \text{ Weight} - 0.01 \text{ Height*Weight}),$$

and the JGL gamma fitted FSIQ dispersion ($\hat{\sigma}^2$) model is

$$\hat{\sigma}^2 = \text{exp.}(11.48 - 0.01 \text{ Brain size} - 0.67 \text{ Gender}).$$

VIQ Results: Table 1 shows that mean VIQ is directly associated with the full brain size (P<0.01), while it is inversely associated with height (P<0.01) and gender (P=0.01). Variance of VIQ is inversely partially associated with the full brain size (P=0.07). In the VIQ variance model, an insignificant effect gender is included for better fitting.

JGL gamma fitted VIQ mean ($\hat{\mu}$) model (Table 1) is

$$\hat{\mu} = \text{exp.}(6.79 + 0.01 \text{ Brain size} -- 0.05 \text{ Height} - 0.20 \text{ Gender}),$$

and the JGL gamma fitted VIQ dispersion ($\hat{\sigma}^2$) model is

$$\hat{\sigma}^2 = \text{exp.}(10.78 - 0.01 \text{ Brain size} -0.77 \text{ Gender}).$$

DISCUSSION

The considered IQ data set is a multivariate structure, where the relationship between two variables can be located using only appropriate modeling. Das and Ghosh (2020) have shown that the considered IQ data set is heteroscedastic. Therefore, the three responses PIQ, or FSIQ, or VIQ are modeled separately on the physical characters using JGLMs under both gamma and lognormal distributions. It is noted that the gamma model gives better fit for all three responses, so only JGL gamma fitted results are reported in Table 1. One can verify the reported results (in Table 1) using the data set in the Appendix. Only an appropriate model can identify the real associations between two variables, which has been reported by Das and Ghosh (2020) for the considered IQ data set. Best of our knowledge, joint lognormal and gamma models are not adopted to locate the relationships of PIQ, or FSIQ, or VIQ on the physical characters in the prior studies. In addition, all the reported results (in Table 1) have been verified with model diagnostic tools. The present results are completely new and interesting in the IQ study literature.

Table 1 reveals the summarized FSIQ, PIQ, VIQ data analysis findings. It is developed herein that mean PIQ is directly associated with the full brain size (P<0.01), implying that PIQ is always higher for the people with bigger full brain size than smaller. This finding supports Galton's (1888) studies. It supports all the earlier studies (Rushton and Ankney, 2009; Black *et al.* 2010; Mackintosh, 2011; Warsito *et al.* 2012). In addition, mean PIQ is inversely associated with height (P=0.01), concluding that shorter people have higher PIQ than taller, which is not clearly established in the prior studies (Rushton and Ankney, 2009; Black *et al.* 2010; Mackintosh, 2011; Warsito *et al.* 2012). Variance of PIQ is inversely partially associated with the full brain size (P=0.09), implying that scatteredness of PIQ levels is smaller for the people having greater brain size. That is, most of the people having greater brain size must have higher PIQ levels, which also supports the mean model result. This is not derived in any prior research reports (Rushton and Ankney, 2009; Warsito *et al.* 2012). From Table 1, it is noted herein that PIQ is not related with gender, body weight and BIM.

From Table 1, it is developed herein that mean FSIQ is directly associated with the full brain size (P<0.01), implying that FSIQ is always higher for the people with bigger full brain size than smaller. This finding supports Galton's (1888) studies. Mean FSIQ is also directly associated with weight (P=0.02) and partially with height (P=0.08), while it is inversely associated with the interaction effect of height and weight (Height*Weight) (P=0.02). This indicates that if the joint effect (Height*Weight) is low, FSIQ is high. That is, people with low body weight and shorter size have higher FSIQ levels. Variance of FSIQ is inversely associated with the full brain size (P=0.01), implying that scatteredness of FSIQ levels is smaller for the people having greater brain size. That is, most of the people having greater brain size must have higher FSIQ levels, which also supports the mean model result. This is not derived in any prior research reports (Rushton and Ankney, 2009; Warsito *et al.* 2012). From Table 1, it is noted herein that FSIQ is not related with gender and BIM.

From Table 1, it is developed herein that mean VIQ is directly associated with the full brain size (P<0.01), implying that VIQ is always higher for the people with bigger full brain size than smaller. This finding supports Galton's (1888) studies. Mean VIQ is inversely associated with height (P<0.01), concluding that shorter people have higher VIQ than taller, which is not clearly established in the prior studies (Rushton and Ankney, 2009; Black *et al.* 2010; Mackintosh, 2011; Warsito *et al.* 2012). In addition, mean VIQ is inversely associated with gender (male=1, female=2) (P=0.01), implying that VIQ is higher for male than females. It supports Ankney's (1992) study. Variance of VIQ is inversely partially associated with the full brain size (P=0.07), concluding that scatteredness of VIQ levels is smaller for the people having greater brain size. That is, most of the people having greater brain size must have higher VIQ levels, which also supports the mean model result. This is not derived in any prior research reports (Rushton and Ankney, 2009; Warsito et al. 2012). From Table 1, it is noted herein that VIQ is not related with weight and BIM.

The derived estimates for PIQ, or FSIQ, or VIQ have smaller standard error (Table 1), interpreting that estimates are stable. The current selected mean and dispersion models of PIQ, or FSIQ, or VIQ have been accepted based on smallest AIC value, smallest standard errors of the estimates, graphical diagnosis and comparison of both lognormal and gamma distributions. The present analysis results satisfy the most prior accepted results. Moreover, it presents many new outcomes and it removes many debates, doubts and contradictory outcomes.

CONCLUSION

The current report presents the relationships of PIQ, or FSIQ, or VIQ with physical characters such as brain size, gender, BMI, height and weight. Table 1 gives all the summarized results. The present outcomes are accepted based on model checking tools, so the research should have a greater faith on the current outcomes. It is expected these results should be valid for any IQ data set that is not verified here as we have not any other data set in hand. The current report will be helpful for the researchers as it presents many relationships which are completely new in the IQ literature. PIQ, or FSIQ, or VIQ is higher for individuals with greater brain size, shorter height, smaller body weight. In addition, VIQ is higher for male than females, and they are irrespective of BMI. Everyone should care about body weight, and the others factors such as gender, height and brain size are not in our control.

Conflict of interest:

The authors confirm that this article content has no conflict of interest.

Acknowledgement:

The author are very much grateful for helping statistical analysis and interpretations to Prof. Poonam Singh, Department of Statistics, University of Delhi, Delhi, India, and Dr. Jinseog Kim, Department of Applied Statistics, Dongguk University, Gyeongju, Korea.

REFERENCES

1. Ankney, C. D. (1992). Sex differences in relative brain size: The mismeasure of woman,too? Intelligence, 16, 329–336.
2. Black SE, Devereux PJ, Salvanes KG (2010). Small family, smart family. Family size and the IQ scores of young men? J Hum Res. *45*:33–58.
3. Broca, P. (1873). Sur les cranes de la caverne de l'Homme Mort (Loere). Revue d'Anthropologie*, 2*, 1–53.
4. Broman, S. H., Nichols, P. L., & Kennedy, W. (1975). Preschool IQ: Prenatal and Early Development Correlates. Hillsdale, NJ: Erlbaum.
5. Broman, S. H., Nichols, P. L., Shaughnessy, P. & Kennedy, W. (1987). Retardation in Young Children. Hillsdale, NJ: Erlbaum.
6. Darwin, C. (1871). The Descent of Man. London: Murray.
7. Das, M. and Ghosh, C. (2020). Relationship between performance intelligence quotient and physical characteristics. The International Journal of Social Sciences and Humanities Invention, 7(11): 6256-6264. DOI:10.18535/ijsshi/v7i11.01
8. Das R.N. and Lee Y. (2009). Log-normal versus gamma models for analyzing data from quality-improvement experiments. Quality Engineering, 21(1): 79-87.
9. Firth, D. (1988). Multiplicative errors: Lognormal or gamma?, Journal of the Royal Statistical Society B, 50:266–268.
10. Galton, F. (1888). Head growth in students at the University of Cambridge. Nature*, 38*, 14–15.
11. Gould, S. J. (1996). The Mismeasure of Man, 2nd ed. New York: Norton.
12. Gur, R. C., Mozley, P. D., Resnick, S. M., Gottlieb, G. L., Kohn, M., Zimmerman, R., et al. (1991). Gender differences in age effect on brain atrophy measured by magnetic resonance imaging. Proceedings of the National Academy of Sciences, U.S.A., 88, 2845–2849.
13. Hastie T, Tibshirani R, Friedman J (2009). The Elements of Statistical Learning, Springer-Verlag.
14. Lee Y, Nelder JA, Pawitan Y. (2017). Generalized Linear Models with Random Effects (Unified Analysis via H–likelihood) (Second Edition), London: Chapman & Hall 2017.
15. Mackintosh N (2011). IQ and Human Intelligence. In: Mackintosh N (Ed.), IQ and Human Intelligence (2nd edn), Oxford University Press, UK.
16. Morton, S. G. (1849). Observations on the size of the brain in various races and families of man. Proceedings of the Academy of Natural Sciences Philadelphia*, 4*, 221–224.
17. Myers, R. H., Montgomery, D. C., Vining, G. G. (2002). Generalized Linear Models with Applications in Engineering and the Sciences. New York: John Wiley & Sons.
18. Pearson, K. (1906). On the relationship of intelligence to size and shape of head, and to other physical and mental characters. Biometrika, 5, 105–146.

19. Rushton, J. P., Ankney, C. D. (1995). Brain size matters: A reply to Peters. Canadian Journal of Experimental Psychology, 49, 562–569.
20. Rushton, J. P., & Ankney, C. D. (1996). Brain size and cognitive ability: Correlations with age, sex, social class, and race. Psychonomic Bulletin and Review 3, 21–36.
21. Rushton, J. P., & Ankney, C. D. (2007). The evolution of brain size and intelligence.
22. In S. M. Platek, J. P. Keenan, & T. K. Shackelford (eds.), Evolutionary Cognitive Neuroscience. Cambridge, MA: MIT Press, 121–161.
23. Rushton, J. P. and Ankney, C. D. (2009). Whole brain size and general mental ability: A review. International Journal of Neuroscience, 119, 692–732.
24. Spearman, C. (1904). "General intelligence," objectively determined and measured. American Journal of Psychology, *15*, 201–292.
25. Searman, C. (1927). The Abilities of Man: Their Nature and Measurement. NewYork: Macmillan.
26. Topinard, P. (1878). Anthropology. London: Chapman and Hall.
27. Warsito O, Khomsan A, Hernawati N, Anwar F. (2012). Relationship between nutritional status, psychosocial stimulation, and cognitive development in preschool children in Indonesia. Nutr Res Pract. *6*:451–457.
28. Willerman, L., Schultz, R., Rutledge, J. N., & Bigler, E. D. (1991). *In vivo* brain size and intelligence. *Intelligence, 15*, 223–228.
29. Wechsler, D. (1981). *Manual for the Wechsler Adult Intelligence Scale-Revised (WAIS-R).* San Antonio, TX: The Psychological Corporation.

APPENDIX

AP 1: Intelligence data along with BMI

Gender	FSIQ	VIQ	PIQ	Weight	Height	MRI Count	BMI
Female	133	132	124	118	64.5	816932	19.93967
Male	139	123	150	143	73.3	1038437	18.71041
Male	133	129	128	172	68.8	965353	25.54506
Female	137	132	134	147	65	951545	24.45941
Female	99	90	110	146	69	928799	21.55808
Female	138	136	131	138	64.5	991305	23.31927
Female	92	90	98	175	66	854258	28.24265
Male	89	93	84	134	66.3	904858	21.43054
Male	133	114	147	172	68.8	955466	25.54506
Female	132	129	124	118	64.5	833868	19.93967
Male	141	150	128	151	70	1079549	21.66388
Male	135	129	124	155	69	924059	22.887

Female	140	120	147	155	70.5	856472	21.92344
Female	96	100	90	146	66	878897	23.56244
Female	83	71	96	135	68	865363	20.52444
Female	132	132	120	127	68.5	852244	19.02733
Male	100	96	102	178	73.5	945088	23.16331
Female	101	112	84	136	66.3	808020	21.7504
Male	80	77	86	180	70	889083	25.82449
Male	97	107	84	186	76.5	905940	22.3432
Female	135	129	134	122	62	790619	22.31165
Male	139	145	128	132	68	955003	20.06834
Female	91	86	102	114	63	831772	20.19199
Male	141	145	131	171	72	935494	23.18924
Female	85	90	84	140	68	798612	21.2846
Male	103	96	110	187	77	1062462	22.17254
Female	77	83	72	106	63	793549	18.77501
Female	130	126	124	159	66.5	866662	25.27605
Female	133	126	132	127	62.5	857782	22.85594
Male	144	145	137	191	67	949589	29.91156
Male	103	96	110	192	75.5	997925	23.67896
Male	90	96	86	181	69	879987	26.72611
Female	83	90	81	143	66.5	834344	22.73255
Female	133	129	128	153	66.5	948066	24.32223
Male	140	150	124	144	70.5	949395	20.36759
Female	88	86	94	139	64.5	893983	23.48825
Male	81	90	74	148	74	930016	19
Male	89	91	89	179	75.5	935863	22.0757

Image *Author -1*	***Author Name – Corresponding Author:*** **Mahashweta Das**[1] *Author Affiliation:* **[1]Department of History, Rabindra Bharati University, Kolkata-700050, West Bengal, India**
Image *Author -2*	***Author Name:*** **Prabir Chakraborty**[2] *Author Affiliation:* **[2]Departmkent of Political Science, Govt. Degree College Gandacherra, Dhalai, Tripura, India**