



# Differences in cognitive ability, per capita income, infant mortality, fertility and latitude across the states of India



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## ARTICLE INFO

### Article history:

Received 11 October 2014

Received in revised form 26 January 2015

Accepted 26 January 2015

Available online xxxx

### Keywords:

IQ

Income

Fertility

Muslims

India

## ABSTRACT

Regional differences in cognitive ability are presented for 33 states and union territories of India. Ability was positively correlated with GDP per capita, literacy and life expectancy and negatively correlated with infant and child mortality, fertility and the percentage of Muslims. Ability was higher in the south than in the north and in states with a coast line than with those that were landlocked.

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## 1. Introduction

There have been several studies of regional differences in intelligence within countries and their association with per capita income, educational attainment, infant mortality, life expectancy and other socio-economic phenomena. The first of these studies gave data for intelligence differences in 13 regions of the British Isles in the mid-twentieth century and reported that the highest IQ was in London and the south east, and the lowest IQs were in Scotland, Northern Ireland and the Republic of Ireland (Lynn, 1979). These regional IQs were positively correlated with per capita income ( $r = .73$ ), with intellectual achievement indexed by fellowship of the Royal Society ( $r = .94$ ), and negatively with infant mortality ( $r = -.78$ ).

Similar results have been found in France, where regional differences in intelligence were reported for the mid-1950s by Montmollin (1958). IQs were obtained from 257,000 18 year old male conscripts into the armed forces, and mean IQs were given for the 90 French departments. The highest IQs were obtained by conscripts from the Paris region and the lowest by

conscripts from Corsica. As in the British Isles, it was shown that these departmental IQs were positively correlated with average earnings ( $r = .61$ ), with intellectual achievement indexed by membership of the Institut de France ( $r = .26$ ), and negatively with infant mortality ( $r = .30$ ) (Lynn, 1980).

An association between regional IQs and per capita income has been reported in the United States by McDaniel (2006) who calculated the IQs of the populations of the American states and found that these were highest in the north-eastern states of Massachusetts (104.3), New Hampshire (104.2) and Vermont (103.8), and lowest in the southern states of Mississippi (94.2) and Alabama (95.7), and in California (95.5). The average state IQs were positively correlated with gross state product per capita (a measure of per capita income) ( $r = .28$ ) and with health ( $r = .75$ ), and negatively with violent crime ( $r = -.58$ ).

Further regional differences in IQs have been reported for twelve regions of Italy and their significant correlations with several socio-economic variables including per capita income ( $r = .94$ ), stature ( $r = .93$ ) and infant mortality ( $r = -.86$ ) (Lynn, 2010a). This study has generated a number of critical papers and replies by Lynn (2010b) and Piffer and Lynn (2014). Differences in IQs have been reported for five regions of

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Portugal, where the IQ and per capita income were highest in central Lisbon than in the provinces (Almeida, Lemos, & Lynn, 2011). Differences in IQs have been reported for eighteen regions of Spain and significant correlations with per capita income ( $r = .40$ ), life expectancy ( $r = .75$ ), employment ( $r = .80$ ) and literacy ( $r = .81$ ) (Lynn, 2012). Differences in IQs have been reported for thirty-one regions of China with significant correlations with per capita income ( $r = .42$ ) and years of education ( $r = .69$ ) (Lynn & Cheng, 2013). Regional differences in IQ have been estimated for forty seven regions of Japan and significant correlations reported with per capita income ( $r = .51$ ), lower rates of homicide ( $r = .60$ ) and lower rates of divorce ( $r = .69$ ) (Kura, 2013). Differences in IQs have been reported for four regions of Finland with a positive correlation with per capita income ( $r = .67$ ) and a negative correlation with infant mortality ( $r = -.79$ ) (Dutton & Lynn, 2014).

In this paper we present data for regional differences in intelligence, per capita income, literacy, life expectancy, infant and child mortality, and latitude in India.

## 2. Method

India has 30 states and 6 union territories. There were 29 states until June 2, 2014, when a new state called Telangana was split from Andhra Pradesh. In the present study, data are given for 28 states and 5 union territories because no relevant data are available for the state of Assam and the union territory of Lakshdweep. The difference between states and union territories is that states have their own governments and administrations units while union territories are administered by the central government.

Five measures of cognitive ability were obtained in 2012 for 28 states and 5 union territories (UTs). These were

1. Language Scores Class III (T1). These data consisted of the language scores of class III 11–12 year old school students in the National Achievement Survey (NAS) carried out in Cycle-3 by the National Council of Educational Research and Training (2013). The population sample comprised 104,374 students in 7046 schools across 33 states and union territories (UTs). The sample design for each state and UT involved a three-stage cluster design which used a combination of two probability sampling methods. At the first stage, districts were selected using the probability proportional to size (PPS) sampling principle in which the probability of selecting a particular district depended on the number of class 5 students enrolled in that district. At the second stage, in the chosen districts, the requisite number of schools was selected. PPS principles were again used so that large schools had a higher probability of selection than smaller schools. At the third stage, the required number of students in each school was selected using the simple random sampling (SRS) method. In schools where class 5 had multiple sections, an extra stage of selection was added with one section being sampled at random using SRS. The language test consisted of reading comprehension and vocabulary, assessed by identifying the word for a picture. The test contained 50 items and the scores were analyzed using both Classical Test Theory (CTT) and Item Response Theory (IRT). The scores were transformed to a scale of 0–500 with a mean of 250 and standard deviation of 50.
2. Mathematics Scores Class III (T2). These data consisted of the mathematics scores of Class III school students obtained by the same sample as for the Language Scores Class III described above. The test consisted of identifying and using numbers, learning and understanding the values of numbers (including basic operations), measurement, data handling, money, geometry and patterns. The test consisted of 50 multiple-choice items scored from 0 to 500 with a mean score was set at 250 with a standard deviation of 50.
3. Language Scores Class VIII (T3). These data consisted of the language scores of class VIII (14–15 year olds) obtained in the NAS (National Achievement Survey) a program carried out by the National Council of Educational Research and Training, 2013) Class VIII (Cycle-3). The sampling methodology was the same as that for class III described above. The population sample comprised 188,647 students in 6722 schools across 33 states and union territories. The test was a more difficult version of that for class III, and as for class III, scores were analyzed using both Classical Test Theory (CTT) and Item Response Theory (IRT), and were transformed to a scale of 0–500 with a mean 250.
4. Mathematics Scores Class VIII (T4). These data consisted of the mathematics scores of Class VIII (14–15 year olds) school students obtained by the same sample as for the Language Scores Class VIII described above. As with the other tests, the scores were transformed to a scale of 0–500 with a mean 250 and standard deviation of 50.
5. Science Scores Class VIII (T5). These data consisted of the science scores of Class VIII (14–15 year olds) school students obtained by the same sample as for the Language Scores Class VIII described above. As with the other tests, the scores were transformed to a scale of 0–500 with a mean 250 and standard deviation of 50. The data were obtained in 2012.
6. Teachers' Index (TI). This index measures the quality of the teachers and was taken from the Elementary State Education Report compiled by the District Information System for Education (DISE, 2013). The data were recorded in September 2012 for teachers of grades 1–8 in 35 states and union territories. The sample consisted of 1,431,702 schools recording observations from 199.71 million students and 7.35 million teachers. The teachers' Index is constructed from the percentages of schools with a pupil-teacher ratio in primary greater than 35, and the percentages single-teacher schools, teachers without professional qualification, and female teachers (in schools with 2 and more teachers).
7. Infrastructure Index (II). These data were taken from the Elementary State Education Report 2012–13 compiled by the District Information System for Education (2013). The sample was the same as for the Teachers' Index described above. This index measures the infrastructure for education and was constructed from the percentages of schools with proper chairs and desks, drinking water, toilets for boys and girls, and with kitchens.
8. GDP per capita (GDP per cap). These data are the net state domestic product of the Indian states in 2008–09 at constant prices given by the Reserve Bank of India (2013). Data are not available for the Union Territories.

9. Literacy Rate (LR). This consists of the percentage of population aged 7 and above in given in the 2011 census published by the [Registrar General and Census Commission of India \(2011\)](#).
10. Infant Mortality Rate (IMR). This consists of the number of deaths of infants less than one year of age per 1000 live births in 2005–06 given in the National Family Health Survey, Infant and Child Mortality given by the [Indian Institute of Population Sciences \(2006\)](#).
11. Child Mortality Rate (CMR). This consists of the number of deaths of children 1–4 years of age per 1000 live births in the 2005–06 given by the [Indian Institute of Population Sciences \(2006\)](#).
12. Life Expectancy (LE). This consists of the number of years an individual is expected to live after birth, given in a 2007 survey carried out by [Population Foundation of India \(2008\)](#).
13. Fertility Rate (FR). This consists of the number of children born per woman in each state and union territories in 2012 given by [Registrar General and Census Commission of India \(2012\)](#).
14. Latitude (LAT). This consists of the latitude of the center of the state.
15. Coast Line (CL). This consists of whether states have a coast line or are landlocked and is included to examine whether the possession of a coastline is related to the state IQs.
16. Percentage of Muslims (MS). This is included to examine a possible relation to the state IQs.

### 3. Results

Descriptive statistics of the data are given in [Tables 1 and 2](#). In [Table 1](#) the first column lists the 28 states given in alphabetical order, followed by the 5 union territories. Columns 2 through 6 give the scores on the five tests of language, math and science (T1: Language scores viii, T2: Mathematics scores viii, T3: Science Score viii, T4: Language Scores iii, T5: Maths scores iii). Column 7 gives cognitive ability (CA) calculated as the average of the scores on the five tests of language, math and science.

The first column of [Table 2](#) lists the thirty three states and union territories. Column 2 gives the percentage of population literate (Lit). Columns 3 and 4 give the Infrastructure Index (II) and the Teachers' Index (TI). Column 5 gives the GDP per capita. Columns 6 and 7 give the Infant Mortality Rate (IMR) and the Child Mortality Rate (CMR). Column 8 gives the fertility rate (FER). Column 9 gives Life Expectancy (LE). Column 10 gives the latitude of the state (Lat). Column 11 gives dichotomous data for whether states have a cost line entered as 1 and those that are landlocked entered as 0 (CL). Column 12 gives the percentage of Muslims (MS).

[Table 3](#) gives the Pearson correlations between the variables except for bi-serial correlations for those with or without coast lines. Correlations higher than .34 are statistically significant at the 0.05 level (2-tailed) and correlations higher than .43 are statistically significant at the 0.01 level (2-tailed), except for those with GDP per capita for which correlations higher than .38 are statistically significant at the 0.05 level (2-tailed) and correlations higher than .49 are statistically significant at the 0.01 level (2-tailed).

**Table 1**

Cognitive ability data for the states of India.

States/Uts	T1	T2	T3	T4	T5	CA
Andhra Pradesh	244	232	237	253	259	245.0
Arunachal Pradesh	234	232	241	247	245	239.8
Bihar	242	251	241	227	230	238.2
Chattisgarh	245	238	244	226	222	235.0
Goa	258	239	265	274	248	256.8
Gujarat	247	231	247	262	255	248.4
Haryana	250	246	250	238	238	244.4
Himanchal Pradesh	259	248	251	256	258	254.4
Jammu Kashmir	217	256	256	232	240	228.8
Jharkhand	242	260	250	242	249	248.6
Karnataka	244	243	241	267	265	252.0
Kerala	277	236	261	273	264	262.2
Madhya Pradesh	246	267	258	239	243	250.6
Maharashtra	267	242	249	271	262	258.2
Manipur	239	260	261	267	263	258.0
Meghalaya	229	227	232	252	241	236.2
Mizoram	244	249	253	278	265	257.8
Nagaland	245	238	244	255	249	246.2
Odisha	245	243	256	250	241	247.0
Punjab	260	251	250	249	258	253.6
Rajasthan	241	247	248	238	236	242.0
Sikkim	248	231	261	274	257	254.2
Tamil Nadu	251	239	247	274	271	258.4
Tripura	239	264	265	281	262	262.2
Uttarkhand	240	229	231	239	243	236.4
Uttar Pradesh	247	278	259	252	257	258.6
West Bengal	259	250	257	271	255	258.4
A & N Islands	248	252	267	262	255	256.8
Chandigarh	264	241	249	243	240	247.4
D & N Haveli	248	258	277	274	267	264.8
Daman & Diu	273	260	282	280	279	274.8
Delhi	248	228	237	253	244	242.0
Puducherry	233	227	230	280	271	248.2

T1–T5: test scores in language, math; and science; CA: cognitive ability.

### 4. Discussion

We propose that the five measures of literacy, math and science given in [Table 1](#) and averaged as cognitive ability should be regarded as measures of intelligence in the same way that the PISA tests of these three abilities have been adopted as measures of intelligence across nations and across regions within nations in a number of studies, e.g. across nations by [Rindermann \(2007, 2008a, 2008b\)](#), [Hunt and Wittmann \(2008\)](#) and [Lynn and Vanhanen \(2012\)](#), and across regions within nations for Italy and Spain by [Lynn \(2010a, 2010b, 2012\)](#). More generally, correlations between educational assessments and IQs range between .77 and .94 ([Kaufman, Reynolds, Liu, Kaufman, & McGrew, 2012](#)) and the respective latent traits correlate above .80 ([Sonnleitner, Keller, Martin, & Brunner, 2013](#)). Adopting this assumption, it can be noted that the cognitive ability scores range from the lowest of 228.8 in Jammu-Kashmir to the highest of 274.8 in Daman and Diu. The difference of 46 is slightly less than the standard deviation of 50 and is therefore equivalent to approximately 15 IQ points. This range is greater than the 10.1 IQ point difference between the lowest and highest average IQ in the American states of Mississippi (94.2) and Massachusetts (104.3) calculated by [McDaniel \(2006a\)](#).

The correlations given in [Table 3](#) show that the intelligence in the states (given as cognitive ability in [Table 1](#)) is positively correlated with the GDP per capita, the Teachers' Index, the Infrastructure Index, the Literacy Rate, Life expectancy and

**Table 2**

Socio-economic data for the states of India.

States Uts	Lit	II	TI	GDP	IMR	CMR	FER	LE	LAT	CL	MS
Andhra Pradesh	67.66	0.56	0.903	27,362	53.5	10.2	1.8	70.2	16.5	0	9.17
Arunachal Pradesh	66.95	0.528	0.601	22,475	60.7	28.8	2.8	73.6	27.06	1	1.88
Bihar	63.82	0.573	0.468	10,206	61.7	24.7	3.5	69.3	25.37	1	16.53
Chattisgarh	71.04	0.451	0.559	19,521	70.8	21	2.7	65.8	21.27	1	11.97
Goa	87.4	0.665	0.92	60,232	15.3	5	1.8	76.9	15.49	0	6.84
Gujarat	79.31	0.814	0.848	31,780	49.7	11.9	2.3	70.4	23.27	0	9.06
Haryana	76.64	0.703	0.82	41,896	41.7	11.1	2.3	70.6	30.73	1	5.78
Himanchal Pradesh	83.78	0.681	0.789	32,343	36.1	5.6	1.7	72.3	31.1	1	1.97
Jammu & Kashmir	68.74	0.384	0.872	17,590	44.7	6.8	1.9	70.5	33.45	1	66.97
Jharkhand	67.63	0.584	0.4033	16,294	68.7	26.1	2.8	71.3	23.35	1	13.85
Karnataka	75.6	0.837	0.848	27,385	43.2	10.2	1.9	70.4	12.9	0	12.23
Kerala	93.91	0.722	0.949	35,457	15.3	1	1.8	78.9	8.5	0	11.7
Madhya Pradesh	70.63	0.654	0.408	13,299	69.5	26.5	3.2	64.8	23.25	1	6.37
Maharashtra	82.91	0.799	0.775	33,302	37.5	9.5	1.8	7.3	18.96	0	10.6
Manipur	79.85	0.699	0.707	16,508	29.7	12.6	2	75.9	24.31	1	8.81
Meghalaya	75.48	0.211	0.697	23,069	44.6	27.1	2	70.4	25.57	1	4.28
Mizoram	91.58	0.539	0.773	20,483	34.1	19.5	2	76.9	23.3	1	1.14
Nagaland	80.11	0.358	0.739	17,129	38.3	27.5	2	75.9	25.57	1	1.76
Odisha	73.45	0.544	0.602	18,212	64.7	27.6	2.1	66.5	20.15	1	2.07
Punjab	76.68	0.716	0.923	33,198	41.7	10.8	1.7	73.2	30.79	1	6.09
Rajasthan	67.06	0.745	0.579	19,708	65.3	21.5	2.9	68.8	26.57	1	1.57
Sikkim	82.2	0.675	0.841	30,652	33.7	6.7	2	75.6	27.33	1	1.42
Tamil Nadu	80.33	0.802	0.847	30,652	30.4	5.3	1.7	73.4	13.09	0	5.56
Tripura	87.75	0.613	0.627	12,481	51.5	8.2	1.8	73.6	23.84	1	7.95
Uttarkhand	79.63	0.648	247,200.595	25,114	41.9	15.5	2	73.5	30.33	1	11.92
Uttar Pradesh	69.72	0.654	0.264	12,481	72.7	25.6	3.3	67.7	26.85	1	18.5
West Bengal	77.08	0.486	0.629	24,720	48	12.2	1.7	70.5	22.56	0	25.25
A & N Islands	86.27	0.682	0.971	NA	30	NA	1.8	76.9	11.68	0	8.22
Chandigarh	86.43	0.685	0.92	NA	32	7.1	1.8	76.9	30.75	1	3.95
D & N Haveli	77.65	0.653	0.67	NA	34	NA	2	70.5	20.27	0	2.96
Daman & Diu	87.07	0.818	0.868	NA	36	NA	1.9	73.5	20.42	0	7.76
Delhi	86.34	0.713	0.817	NA	39.8	7.3	1.8	73	28.61	1	11.72
Puducherry	86.55	0.703	0.987	NA	21	NA	1.8	76.9	11.93	0	6.09

LIT: percentage of population literate; II: Infrastructure Index; TI: Teachers' Index; GDP: Gross domestic product per capita; IMR: Infant Mortality Rate; CMR: Child Mortality Rate; FER: Fertility rate; LE: Life Expectancy; LAT: Latitude; CL: coast line; MS: Muslims.

having a coast line, and negatively correlated the Infant Mortality Rate, the Child Mortality Rate, the Fertility Rate, Latitude and the percentage of Muslims.

We propose the following interpretations of these correlations. The positive correlation of intelligence with GDP per

capita at .25 is consistent with the positive correlation of intelligence with measures of per capita income across the regions in the British Isles, France, the United States, Italy, Spain, China, Japan and Portugal, as noted in the introduction. The present result shows that this positive association is also

**Table 3**

Correlation matrix for cognitive and socio-economic data for the states of India.

	T1	T2	T3	T4	T5	CA	LIT	II	TI	Gdp	IMR	CMR	FER	LE	LAT	CL
T2	0.05															
T3	0.41	0.63														
T4	0.35	-0.02	0.41													
T5	0.34	0.14	0.37	0.87												
CA	0.65	0.42	0.72	0.79	0.81											
LIT	0.51	-0.19	0.29	0.71	0.53	0.56										
II	0.52	0.09	0.24	0.36	0.48	0.52	0.33									
TI	0.28	-0.49	0.02	0.44	0.39	0.17	0.62	0.28								
GDP	0.54	-0.47	0.11	0.36	0.21	0.25	0.48	0.37	0.69							
IMR	-0.45	0.38	-0.19	-0.59	-0.48	-0.39	-0.79	-0.23	-0.81	-0.67						
CMR	-0.46	-0.21	-0.28	-0.47	-0.46	-0.37	-0.61	-0.51	-0.76	-0.62	0.73					
FER	-0.27	0.36	-0.09	-0.59	-0.51	-0.35	-0.69	-0.12	-0.79	-0.51	0.75	0.71				
LE	0.28	-0.29	0.11	0.57	0.46	0.34	0.76	0.19	0.65	0.43	-0.85	-0.51	-0.59			
LAT	-0.27	0.14	-0.14	-0.55	-0.47	-0.43	-0.31	-0.29	-0.31	-0.28	0.22	0.19	0.23	-0.23		
CL	-0.41	0.16	-0.22	-0.61	-0.60	-0.50	-0.32	-0.43	-0.49	-0.54	0.42	0.55	0.42	-0.24	0.78	
MS	-0.33	0.24	0.03	-0.28	-0.17	-0.32	-0.28	-0.26	-0.03	-0.19	0.07	-0.20	0.01	-0.07	0.19	0.01

T1–T5: test scores in language, math, and science; CA: cognitive ability; LIT: percentage of population literate; II: Infrastructure Index; TI: Teachers' Index; GDP: Gross domestic product per capita; IMR: Infant Mortality Rate; CMR: Child Mortality Rate; FER: Fertility rate; LE: Life Expectancy; LAT: Latitude; CL: coast line; MS: Muslims.

present in India. The correlation across the Indian states is lower than those in several countries but closely similar to the correlation of intelligence with GDP per capita of .28 across the American states reported by *McDaniel (2006a)*. We propose that these positive correlations arise because intelligence is a determinant of income among individuals shown by *Jencks (1972)* and confirmed by a number of subsequent studies summarized in a meta-analysis of 85 data sets drawn from the United States, the United Kingdom, Norway, Australia, New Zealand, Estonia, Netherlands and Sweden by *Strenze (2007)* that concluded that in all studies the correlation between intelligence and income is positive averaging .20, in the best studies the correlation is .23, and for 35–78 year olds the correlation weighted by sample size is .25. This meta-analysis did not include a more recent study of a national sample in Britain in which a correlation of .37 between IQ obtained at the age of 8 years and income at the age 43 years was found for men, and a correlation of .32 was obtained for women (*Irwing & Lynn, 2006*).

The positive correlation between IQs in childhood and income in middle age suggests that IQ is causal to subsequent income. This has been confirmed by studies of sibling pairs that have shown that siblings with higher IQs have higher earnings than their lower IQ brothers and sisters (*Bound, Grilliches, & Hall, 1986; Murray, 2002; Rowe, Vesterdal, & Rodgers, 1999*). The use of sibling pairs controls for possible family and neighborhood effects that might affect both IQ and income. The likely explanation for the positive correlation between IQ and income is that those with higher IQs work more efficiently (*Schmidt & Hunter, 1998*) and can supply goods and services with greater value than those with lower IQs, and consequently can command higher incomes. The positive correlation between intelligence and income across populations is to be expected from the correlation among individuals on the grounds that populations are aggregates of individuals, and populations with higher IQs can supply goods and services with greater value than those with lower IQs, and hence command higher incomes.

It is proposed further that these correlations between population IQ and per capita income arise through a positive feed-back loop in which the population's IQ is a determinant of per capita income, and per capita income is a determinant of the population's IQ. Thus, the population's IQ is both a cause and a result of its per capita income. The population's IQ is a cause of its per capita income because individuals and populations with high IQs are able to work more efficiently than those with low IQs and consequently command higher incomes. The population's IQ is a result of its per capita income because populations with high IQs provide a better environment (good nutrition, health care and education) for the development of the intelligence of their children. This positive feed-back loop arises through genotype–environment correlation described by *Plomin, DeFries, and McClearn (1990)*.

The negative correlations between state intelligence and the Infant Mortality Rate ( $r = -.39$ ) and the Child Mortality Rate ( $r = -.37$ ) in the present data for India are consistent with those reported in the British Isles, Finland, France and Italy. We propose that these negative correlations arise because populations with high IQs are more competent in looking after their babies and infants, e.g. by avoiding accidents and providing them with better health care and nutrition. An

association between infant mortality and the low IQ of mothers has been reported by *Savage (1946)*.

The positive correlation between state intelligence and life expectancy ( $r = .34$ ) in the present data for India is consistent with that reported for the regions of Spain ( $r = .75$ ) and the correlation between intelligence and health across the states of the US ( $r = .75$ ), reported by *McDaniel (2006a)*. These positive correlations are consistent with studies of individuals showing that longevity and health are positively associated with intelligence (e.g. *Batty, Deary, & Gottfredson, 2007; Batty, Deary, & Macintyre, 2007; Batty, Shipley, Mortensen, & Deary, 2008; Gottfredson, 2004; Kanazawa (2014)*). There are currently two explanations for the positive relation between intelligence and longevity. The system integrity theory (*Arden, Gottfredson, & Miller, 2009; Deary, 2012; Whalley & Deary, 2001*) proposes that intelligence is an indicator of underlying genetic and developmental health. Genetically and developmentally healthier individuals with greater body system integrity also have higher intelligence, stay healthier and live longer. The second theory proposed by *Kanazawa (2008, 2014)* is that more intelligent individuals are better able to recognize, deal appropriately with and avoid health risks and hazards, and, as a result, stay healthier and live longer.

The correlation between state intelligence and the Teachers' Index ( $r = .17$ ) is positive but low and not statistically significant, suggesting that this measure of teacher quality has little effect on state intelligence. However, it should be noted that the Teacher Index is a very heterogeneous measure.

The positive correlation between state intelligence and the Infrastructure Index ( $r = .52$ ) may be present because states with higher per capita GDP are able to spend more on school infrastructure ( $r = .33$ ). The positive correlation between state intelligence and the Literacy Rate ( $r = .56$ ) may also be present because states with higher per capita GDP are able to spend more on school infrastructure ( $r = .33$ ).

The negative correlation between state intelligence and the fertility rate ( $r = -.35$ ) suggests that the presence of dysgenic fertility consistent with many studies in the contemporary world (*Lynn, 2011*).

We consider now five hypotheses for the explanation of the differences in IQs across the Indian states. First, we examine the cold winters theory that state population IQs may be positively associated with colder winters because of the greater cognitive demands in these colder locations, found in Japan (*Kura, 2013*) and across nations (*Lynn & Vanhanen, 2012*). In India the southern states lie around the 10 degree of latitude and the north-western states lie around the 35 degree of latitude and have colder winters. From the colder winters theory it would be predicted that north-western states would have higher IQs than the southern states. The present result showing a negative correlation between states' IQs and latitude ( $r = -.43$ ) shows that average intelligence tends to be higher in the south of India than in the north and is therefore inconsistent with the cold winters theory.

The second hypothesis to be examined is the selective migration theory that attributes the higher IQs in capital cities found in the British Isles and France to a tendency of those with higher than average IQs to have migrated to the capitals, established families there and transmitted their higher intelligence to succeeding generations. This explanation does not hold for India, where the cognitive ability score of Delhi (242.0) is

lower than the average. A variant of the selective migration theory is that there could have been selective migration from agricultural rural locations into towns and cities. To test these we have examined the relation between the percentage of the population engaged in agriculture and IQ and found a correlation of virtually zero ( $r = -.005$ ).

The third hypothesis to be examined is that racial differences may have contributed to the IQ differences across the Indian states. India is ethnically and genetically quite heterogeneous as a result of substantial immigration from Iran, Afghanistan and southern Asia into the north-western states from around 2000 BC to 1100 AD. This immigration led to genetic differences between the more Indo-European lighter skin tones present in the population of northern India than in the south (Ali et al., 2014). It has been shown that across 58 nations light skin tone is strongly associated with higher IQ at  $r = .89$  by Meisenberg (2004) and confirmed for 129 nations at  $r = .92$  by Templer and Arikawa (2006). From these results it might have been expected that the lighter skinned populations of the north-western states would have higher average IQs. This expectation is disconfirmed by the below average cognitive abilities in most of the north-western states where Jammu-Kashmir has the lowest cognitive ability score of 228.8 and the north-western union territory of Uttarakhand has the second lowest cognitive ability score of 236.4. There are also below average cognitive abilities in four of the other north-western states, namely Arunachal Pradesh (239.8), Chattisgarh (235.0), Haryana (244.4) and Rajasthan (242.0), although the north-western states of Himanchal Pradesh and Punjab have slightly above average cognitive ability scores of 254.4 and 253.6, respectively. These inconsistencies do not support a genetic theory of the tendency of cognitive abilities to be lower in the north-western states.

Possibly the immigration of Portuguese into Goa from the seventeenth century and the later immigration of British into Bombay in the state of Maharashtra (Cavalli-Sforza, Menozzi, & Piazza, 1994; Mastana, 2014) might have contributed to the higher than average cognitive ability scores in these states of 256.8 and 258.2, respectively, but these scores are only marginally above the average and do not support a strong genetic theory.

The fourth hypothesis to be examined is that states with coast lines might have higher per capita income and IQs than those that are landlocked. This hypothesis is derived from Collier's (2008) theory that landlocked countries have lower per capita incomes than those with coast lines because of the greater amount of trade facilitated by the sea ports. In the case of India the hypothesis is that coastal states may have higher per capita incomes and that these would have a positive effect of enhancing IQs. This hypothesis is supported by the significant positive correlations between states with coast lines and per capita income ( $r = .54$ ) and with IQs ( $r = .50$ ). There are also significant negative correlations between states with coast lines and infant mortality rates ( $r = -.42$ ) and child mortality rates ( $r = -.55$ ) attributable to the positive effects of higher per capita income and higher IQ in reducing infant and child mortality. There was a high correlation between the possession of a coast line and latitude ( $r = -.78$ ) showing that more of the southern states have a coast line and suggesting that the possession of a coast line contributes to the higher IQs in southern states.

The fifth hypothesis to be examined is that the percentage of Muslims in states would be negatively associated with IQs. This hypothesis is based on the findings that Muslims in India have a high rate of cousin marriages and the children of these have lower average IQs of 14 to 25 IQ points, respectively, reported in the studies by Badaruddoza (2004) and Fareed and Afzal (2014), compared with those of non-cousin marriages as a result of inbreeding depression. This hypothesis is confirmed by the negative correlation ( $r = -.32$ ) between the percentage of Muslims in the states and the state IQs.

## References

- Ali, M., Liu, X., Pillai, E. N., Chen, P., Khor, C. -C., Ong, R. T. -H., et al. (2014). Characterizing the genetic differences between two distinct migrant groups from Indo-European and Dravidian speaking populations in India. *BMC Genetics*, 15, 86–95.
- Almeida, L. S., Lemos, G. C., & Lynn, R. (2011). Regional differences in intelligence and per capita incomes in Portugal. *Mankind Quarterly*, 52, 213–221.
- Arden, R., Gottfredson, L. S., & Miller, G. (2009). Does a fitness factor contribute to the association between intelligence and health outcomes? Evidence from medical abnormality counts among 3654 US veterans. *Intelligence*, 37, 581–591.
- Badaruddoza, A. (2004). Effect of inbreeding on Wechsler Intelligence Test scores among North Indian children. *Asia-Pacific Journal of Public Health*, 16, 99–103.
- Batty, G. D., Deary, I. J., & Gottfredson, L. S. (2007). Premorbid (early life) IQ and later mortality risk: Systematic review. *Annals of Epidemiology*, 17, 278–288.
- Batty, G. D., Deary, I. J., & Macintyre, S. (2007). Childhood IQ in relation to risk factors for premature mortality in middle aged persons: The Aberdeen children of the 1950s study. *Journal of Epidemiology & Community Health*, 61, 241–247.
- Batty, G. D., Shipley, M. J., Mortensen, L. H., & Deary, I. J. (2008). IQ in late adolescence/early adulthood, risk factors in middle aged persons and later all-cause mortality in men: The Vietnam experience study. *Journal of Epidemiology & Community Health*, 62, 522–531.
- Bound, J., Griliches, Z., & Hall, B. (1986). Wages, schooling and IQ of brothers and sisters: Do family factors differ? *International Economic Review*, 27, 217–230.
- Cavalli-Sforza, L. L., Menozzi, P., & Piazza, A. (1994). *The history and geography of human genes*. Princeton, NJ: Princeton University Press.
- Collier, P. (2008). *The Bottom Billion: Why the poorest countries are failing and what can be done about it*. Oxford: Oxford University Press.
- Deary, I. J. (2012). Looking for 'system integrity' in cognitive epidemiology. *Gerontology*, 58, 545–553.
- District Information System for Education (2013). *Elementary State Education Report 2012–13*. New Delhi: District Information System for Education.
- Dutton, E., & Lynn, R. (2014). Regional differences in intelligence and their social and economic correlates in Finland. *Mankind Quarterly*, 54, 447–456.
- Fareed, M., & Afzal, M. (2014). Estimating the inbreeding depression on cognitive behavior: A population based study of a child cohort. *PLoS ONE*, 9(10), e109585. <http://dx.doi.org/10.1371/journal.pone.0109585>.
- Gottfredson, L. S. (2004). Intelligence: Is it the epidemiologists' elusive "fundamental cause" of social class inequalities in health? *Journal of Personality and Social Psychology*, 86, 174–199.
- Hunt, E., & Wittmann, W. (2008). National intelligence and national prosperity. *Intelligence*, 36, 1–9.
- Indian Institute of Population Sciences (2006). *2005–06 National Family Health Survey 3, Infant and Child Mortality*. New Delhi: Indian Institute of Population Sciences.
- Irwing, P., & Lynn, R. (2006). The relation between childhood IQ and income in middle age. *Journal of Social, Political and Economic Studies*, 31, 191–196.
- Jencks, C. (1972). *Inequality*. London: Penguin.
- Kanazawa, S. (2008). IQ and the health of states. *Biodemography and Social Biology*, 54, 200–213.
- Kanazawa, S. (2014). General intelligence, disease heritability, and health: A preliminary test. *Personality and Individual Differences*, 71, 83–85.
- Kaufman, S. B., Reynolds, M. R., Liu, X., Kaufman, A. S., & McGrew, K. S. (2012). Are cognitive g and academic achievement g one and the same? An exploration of the Woodcock-Johnson and Kaufman tests. *Intelligence*, 40, 123–138.
- Kura, K. (2013). Japanese north-south gradient in IQ predicts differences in stature, skin color, income, and homicide rate. *Intelligence*, 41, 512–516.

- Lynn, R. (1979). The social ecology of intelligence in the British Isles. *British Journal of Social and Clinical Psychology*, 18, 1–12.
- Lynn, R. (1980). The social ecology of intelligence in the France. *British Journal of Social and Clinical Psychology*, 19, 325–331.
- Lynn, R. (2010a). In Italy, north–south differences in IQ predict differences in income, education and infant mortality. *Intelligence*, 38, 93–100.
- Lynn, R. (2010b). IQ differences between the north and south of Italy: A reply to Beraldo and Cornoldi, Belacchi, Giofre, Martini, & Tressoldi. *Intelligence*, 38, 451–455.
- Lynn, R. (2011). *Dysgenics: Genetic deterioration in modern populations* (Second Revised Edition). London: Ulster Institute for Social Research.
- Lynn, R. (2012). North–south differences in Spain in IQ, educational attainment, per capita income, literacy, life expectancy and employment. *Mankind Quarterly*, 52, 265–291.
- Lynn, R., & Cheng, H. (2013). Differences in intelligence across thirty-one regions of China and their economic and demographic correlates. *Intelligence*, 41, 553–559.
- Lynn, R., & Vanhanen, T. (2012). *Intelligence: A unifying construct for the social sciences*. London: Ulster Institute for Social Research.
- Mastana, S. S. (2014). Unity in diversity: An overview of the genomic anthropology of India. *Annals of Human Biology*, 41, 287–335.
- McDaniel, M. A. (2006). State preferences for the ACT versus SAT complicates inferences about SAT-derived state IQ estimates: A comment on Kanazawa (2006). *Intelligence*, 34, 601–606.
- Meisenberg, G. (2004). Talent, character and the dimensions of national culture. *Mankind Quarterly*, 45, 123–168.
- Montmollin, M. (1958). Le niveau intellectuel des recrues du contingent. *Population*, 13, 259–268.
- Murray, C. (2002). IQ and income inequality in a sample of sibling pairs from advantaged family backgrounds. *American Economics Association: Papers and Proceedings*, 92(2), 339–343.
- National Council of Educational Research and Training (2013). *National achievement survey*. New Delhi: National Council of Educational Research and Training.
- Piffer, D., & Lynn, R. (2014). New evidence for differences in fluid intelligence between north and south Italy and against school resources as an explanation for the north–south IQ differential. *Intelligence*, 46, 246–249.
- Plomin, R., DeFries, J. C., & McClearn, G. E. (1990). *Behavioral genetics*. New York: Freeman.
- Population Foundation of India (2008). *The future population of India: A long range demographic view*. New Delhi: Population Foundation of India.
- Registrar General & Census Commission of India (2011). *Provisional Population Totals Paper 1 of 2011 series 1*. New Delhi: Office of Registrar General & Census of India.
- Registrar General & Census Commission of India (2012). *Estimates of fertility indicators, chapter-3 SRS report 2012*. New Delhi: Office of Registrar General & Census Commission of India.
- Reserve Bank of India (2013). *Handbook of statistics on the Indian economy*. New Delhi: Reserve Bank of India.
- Rindermann, H. (2007). The g-factor of international cognitive ability comparisons: The homogeneity of results in PISA, TIMSS, PIRLS and IQ tests across nations. *European Journal of Personality*, 21, 667–706.
- Rindermann, H. (2008a). Relevance of education and intelligence at the national level for the economic welfare of people. *Intelligence*, 36, 127–142.
- Rindermann, H. (2008b). Relevance of education and intelligence for the political development of nations: Democracy, rule of law and political liberty. *Intelligence*, 36, 306–322.
- Rowe, D., Vesterdal, W., & Rodgers, J. (1999). Herrnstein's syllogism: Genetic and shared environmental influences on IQ, education and income. *Intelligence*, 26, 405–423.
- Savage, S. W. (1946). Intelligence and infant mortality in problem families. *British Medical Journal*, 19(Jan), 86–87.
- Schmidt, F. L., & Hunter, J. E. (1998). The validity and utility of selection methods in psychology: Practical and theoretical implications of 85 years of research findings. *Psychological Bulletin*, 124, 262–274.
- Sonnleitner, P., Keller, U., Martin, R., & Brunner, M. (2013). Students' complex problem solving abilities: Their structure and relations to reasoning ability and educational success. *Intelligence*, 41, 289–305.
- Strenze, T. (2007). Intelligence and socioeconomic success: A meta-analytic review of longitudinal research. *Intelligence*, 35, 401–426.
- Templer, D. I., & Arikawa, H. (2006). Temperature, skin color, per capita income and IQ: An international perspective. *Intelligence*, 34, 121–140.
- Whalley, L. J., & Deary, I. J. (2001). Longitudinal cohort study of childhood IQ and survival up to age 76. *British Medical Journal*, 322, 819–823.