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## **Sex Differences in Means and Variance of Intelligence among Middle School Children in the Rural Commune Sidi El Kamel (North-Western Morocco)**

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### **ABSTRACT**

The present study aim to test the hypotheses about equality in means and variance of intelligence between 454 girls and 723 boys (11.8 to 17.7 years) in the middle school of the rural commune Sidi El Kamel (North-Western Morocco). Raven's Standard Progressive Matrices (SPM) test is used to measure the general intelligence; the Mann-Whitney U test and Levene's test are used to test the hypotheses;  $p\text{-value} < 0.05$  is considered statistically significant. No sex differences in means ( $u = 162070$ ;  $p = 0.72 > 0.05$ ) and variance of SPM scores between girls and boys for all age groups ( $F > 2.17$ ;  $ddl > 036$ ;  $p > 0.150 > 0.05$ ) except the age group 13 years ( $p < 0.05$ ), in which boys show more variance of SPM scores. Girls are slightly greater than males in mean of SPM scores until the age of 15 years, from the age of 16 years boys begin slightly greater than girls. The conclusion is no sex differences in means and variance of general intelligence between girls and boys (11.8-17.7 years) among the rural middle school children.

**Key words:** Standard progressive matrices, general intelligence, sex differences, means, variance, Morocco

### **INTRODUCTION**

Raven's Standard Progressive Matrices (SPM) test is widely regarded as the best psychological test of abstract or non-verbal reasoning ability (Lynn *et al.*, 2004; Mackintosh, 1996, 1998). Many of research, bears on its validity (Gregory, 1992). It is a measure of general intelligence (Paul, 1985; Roccatagliata and Benassi, 1981). It was originally developed to assess the eductive ability (Bingham *et al.*, 1966; Raven, 1940, 1989) that is one of Spearman's two components of "g" or general intelligence identified by Spearman (1923, 1927). The figural analogies of SPM are designed regardless of language, culture and knowledge, depend only on current and on-line processing, are said to be tests of fluid intelligence (Burke, 1958; Raven *et al.*, 2000). Furthermore, its is the best known and most widely used tests as measures of individual differences in cognitive ability (DeShon *et al.*, 1995; Powers *et al.*, 1986), also sex differences (Lynn, 1999; Mackintosh and Bennett, 2005).

For around a century, there has been considerable interest in sex differences and international differences in intelligence. There are several studies showing that, on average, males score higher than females on the SPM. Nevertheless, some investigations have demonstrated that there are no

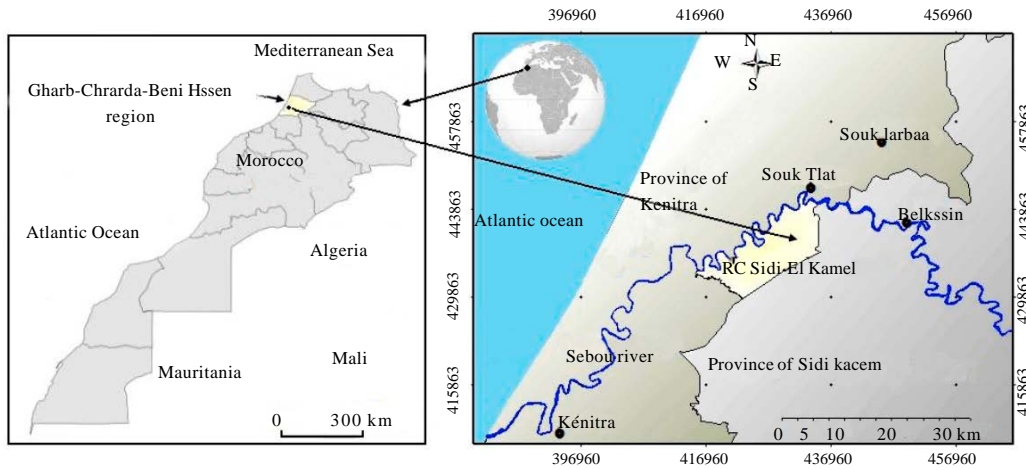


Fig. 1: Geographical situation of rural commune of Sidi El Kamel (North-Western Morocco)

sex differences in “g” (Colom *et al.*, 2004). Colom *et al.* (2004) stated that Lynn and Irwing (2004) have reported a meta-analysis of 87 studies showing that males outperform females on the Progressives Matrices (PM). However, Court (1983) analyzed 118 studies, he found that the majority of studies suggested no difference on Raven’s Progressive Matrices between men and women regarding intelligence. Data on these have been published for many countries but rarely have been published from Morocco. Our purpose in this study is to contribute to the literature on these issues by presenting some data from this country.

This study aims to test the hypotheses: about equality in means and variance of intelligence by SPM test, between 454 girls and 723 boys (11.8-17.7 years) in the middle school of the rural commune Sidi El Kamel (North-Western Morocco).

**Place and population of study:** The survey was carried out between March 2010 and October 2012 at the only middle school of the rural commune Sidi El Kamel, in the province of Sidi Kacem (North-Western Morocco) (Fig. 1); the population includes 1177 middle school children, consisting of 454 girls (38.6%) and 723 boys (61.4%), aged 11.8-17.7 years (Mean = 14.88±SD = 1.47 years), all subjects were tested with consent of their parents and the director of middle school.

## MATERIALS AND METHODS

**Raven’s standard progressive matrices test (SPM) or (PM 38):** This version is published by Raven in 1938 it is intended for adults and children from 12 years, including 60 items presented in black and white grouped into five sets and each set containing 12 items, with increasing level of difficulty within each set. For each item, participants were required to indicate which of six or eight possible symbols correctly completed a sequence of symbols. The maximum possible score is 60 (Raven *et al.*, 1990). The Fig. 2 below shows the first items derived of five sets of SPM test.

**Measures:** The SPM test was administered by a group of competent and trained testers, in two sessions in the morning, in every class of 24-41 middle school children; half an hour for each session: Session 1: Sets (A, B, C) and session 2: Sets (D, E.); verbal instructions were given to them on how to do the test.

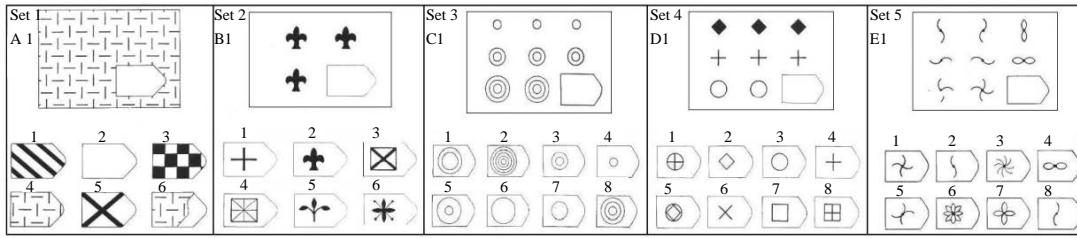


Fig. 2: First items derived of five sets of SPM test

**Data analysis:** Age group 12 years includes students aged 11(9) months to 12 (2) months; Age group 12.5 consists of those aged from 12 (3) to 12 (8) months and similarly for the other age groups. Data was processed using the SPSS v.18 software. Reliability of SPM test scores was investigated using Cronbach's Alpha. Kolmogorov-Smirnov test indicated that SPM scores was not normally distributed  $p > 0.05$ , this allowed to use a non-parametric test Mann-Whitney U to compare differences in means of the SPM scores between two independent groups (Girls and boys). We examined the equality of variances of SPM scores between girls and boys for all age groups by Levene's Test (F). For all tests the  $p < 0.05$  is considered statistically significant. The mean scores; standard deviation; median for each test by sex and age groups are given in tables and figures.

## RESULTS

**Reliabilities of the SPM test:** The reliabilities of the SPM test, as assessed by Cronbach's Alpha (a) as shown in Table 1 below, explain that the properties test are slightly stable across sex and age groups.

**No sex differences in means and variance of intelligence: Graphs:** The Fig. 3 below shows that no considerably sex differences in means and variability of SPM scores between girls and boys.

The Fig. 4 below shows that no considerably sex differences in means and variance of SPM scores between girls and boys according to age groups. Also, we note that the Pearson test revealed a positive correlation statistically significant between age and SPM scores ( $r = 0.23$ ,  $p < 0.01$ ), therefore the SPM scores increase by age groups. We observe also that girls are slightly greater than males in mean of SPM scores until the age of 15 years, from the age of 16 years boys begin slightly greater than girls.

**No sex difference in means and variance of intelligence: Statistical tests:** The Mann-Whitney U test confirms the equality the mean scores of SPM, between girls and boys, for each age groups ( $p > 0.05$ ). The sex differences in  $d < 0$  denote higher mean scores obtained by girls (d is obtained by dividing the difference in means by the average of the SD within the same age group). Therefore, girls are slightly greater than males in mean of SPM scores until the age of 15 years, from the age of 16 years boys begin slightly greater than girls. Table 2 below summarize the comparison by the Mann-Whitney U test of the mean scores of SPM, between girls and boys, according to age groups.

Table 1: Reliabilities as assessed by Cronbach's alpha of the SPM test for the five set by sex and age groups

Parameters	12	12½	13	13½	14	14½	15	15½	16	16½	17	17½
Age in years (months)	11(9)-12 (2)	12 (3)-12 (8)	12 (9)-13 (2)	13 (3)-13 (8)	13 (9)-14 (2)	14 (3)-14 (8)	14 (9)-15 (2)	15(3)-15 (8)	15 (9)-16 (2)	16(3)-16 (8)	16(9)-17 (2)	17(3)-17 (8)
Gender	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
$\alpha$	0.83	0.90	0.85	0.82	0.89	0.86	0.83	0.84	0.88	0.90	0.89	0.90
n	26	12	50	40	35	51	35	41	39	55	59	74
Total	38	90	86	76	94	133	154	137	137	99	81	52

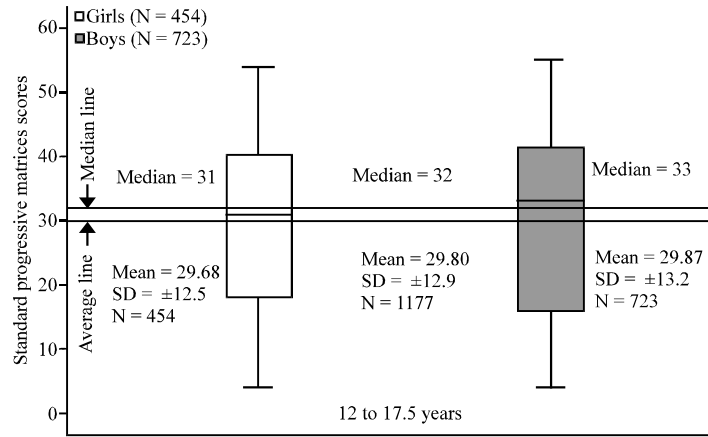


Fig. 3: Means, medians and variability of SPM scores by gender

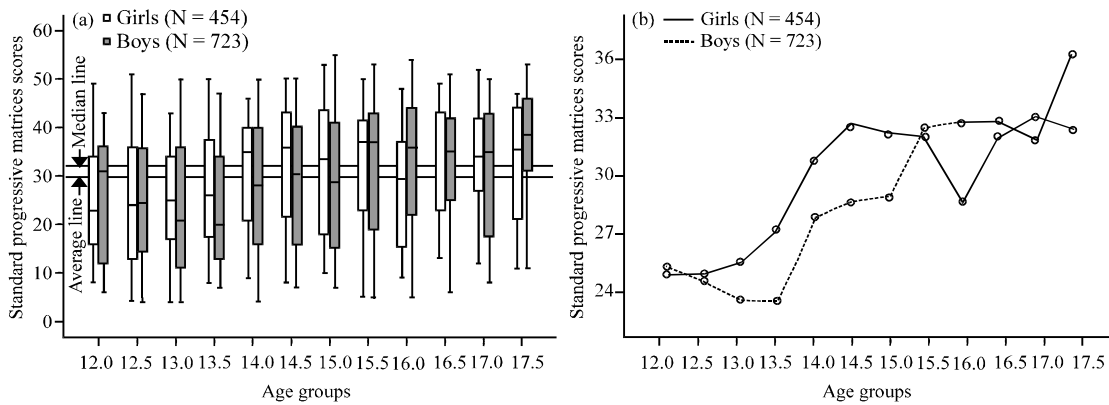


Fig. 4: Medians; variability and mean of SPM scores by sex according to age groups

The Levene's test indicating the homogeneity of variance of SPM scores between girls and boy for all age groups ( $F > 2.17$ ;  $ddl > 0.36$ ;  $p > 0.150 > 0.05$ ), except the age group 13 years ( $p < 0.05$ ); VR (the variance ratios)  $< 1$  denote higher variance scores obtained by girls. (VR obtained by dividing the variance (squared standard deviation) of the boys by the variance of the girls); also the population variances of SPM scores are equal between age groups ( $p = 0.228 > 0.05$ ). The Table 3 below summarize the results of these tests.

**DISCUSSION**

Firstly the reliabilities of the SPM test by sex and age groups as assessed by Cronbach's alpha are between 0.82-0.9, these figures are similar to those found in other countries and continents (Raven *et al.*, 1999). The median scores of the SPM of Girls is 31; the mean is ( $M = 29.68$ ,  $SD = 12.5$ ). For boys the median scores of the SPM is 33; the mean is ( $M = 29.87$ ,  $SD = 13.2$ ). For sex combined, the median is 32; the mean is ( $M = 29.80/60$ ,  $SD = 12.92$ ). The median of the middle school children is equivalent to the 10th percentile of the 1979 British standardisation sample given in Raven *et al.* (1990).

Table 2: Sex differences in means on the standard progressive matrices, between girls (N = 454) and boys (N = 723), according to age groups

Age groups	No. N = 1177	Girls (♀) (Mean±SD)	Boys (♂) (Mean±SD)	Sex differences in means	
				d	Mann-whitney U test
12	26 (♀); 12 (♂)	24.9±10.9	25.3±13.3	0.03	(u = 0155; p = 0.99>0.05); NS <sup>1</sup>
12½	50 (♀); 40 (♂)	24.9±12.0	24.6±12.9	-0.02	(u = 0996; p = 0.97>0.05); NS
13	35 (♀); 51 (♂)	25.6±10.2	23.6±13.2	-0.17	(u = 0773; p = 0.29>0.05); NS
13½	35 (♀); 41 (♂)	27.2±11.8	23.6±11.7	-0.31	(u = 0572; p = 0.13>0.05); NS
14	39 (♀); 55 (♂)	30.8±12.0	27.9±13.3	-0.23	(u = 0945; p = 0.33>0.05); NS
14½	59 (♀); 74 (♂)	32.6±13.0	28.6±13.1	-0.31	(u = 1808; p = 0.09>0.05); NS
15	64 (♀); 90 (♂)	32.2±13.4	28.9±13.3	-0.25	(u = 2440; p = 0.10>0.05); NS
15½	56 (♀); 81 (♂)	32.0±12.6	32.5±13.4	0.04	(u = 2159; p = 0.63>0.05); NS
16	44 (♀); 93 (♂)	28.7±12.3	32.8±12.7	0.33	(u = 1650; p = 0.07>0.05); NS
16½	21 (♀); 78 (♂)	32.0±11.8	32.9±11.4	0.08	(u = 0785; p = 0.77>0.05); NS
17	17 (♀); 64 (♂)	33.0±12.0	31.8±13.1	-0.10	(u = 0526; p = 0.84>0.05); NS
17½	08 (♀); 44 (♂)	32.4±13.6	36.3±12.0	0.30	(u = 0149; p = 0.51>0.05); NS
12 to 17.5	454 (♀); 723 (♂)	29.68±12.5	29.87±13.2	0.01	(u = 162070; p = 0.72>0.05); NS

NS: No statistically significant differences

Table 3: Sex differences in variance on the standard progressive matrices, between girls (N = 454) and boys (N = 723), according to age groups

Age groups	No. N = 1177	Girls (♀) (Mean±SD)	Boys (♂) (Mean±SD)	Sex differences in variance	
				VR	Levene's test for equality of variances
12	26 (♀); 12 (♂)	24.9±10.9	25.3±13.3	1.49	(F = 2.17; ddl = 036; p = 0.150>0.05); NS <sup>1</sup>
12½	50 (♀); 40 (♂)	24.9±12.0	24.6±12.9	1.16	(F = 0.24; ddl = 088; p = 0.627>0.05); NS
13	35 (♀); 51 (♂)	25.6±10.2	23.6±13.2	1.67	(F = 8.76; ddl = 084; p = 0.004<0.05)*
13½	35 (♀); 41 (♂)	27.2±11.8	23.6±11.7	0.98	(F = 0.21; ddl = 074; p = 0.644>0.05); NS
14	39 (♀); 55 (♂)	30.8±12.0	27.9±13.3	1.23	(F = 0.99; ddl = 092; p = 0.323>0.05); NS
14½	59 (♀); 74 (♂)	32.6±13.0	28.6±13.1	1.02	(F = 0.20; ddl = 131; p = 0.660>0.05); NS
15	64 (♀); 90 (♂)	32.2±13.4	28.9±13.3	0.99	(F = 0.06; ddl = 152; p = 0.810>0.05); NS
15½	56 (♀); 81 (♂)	32.0±12.6	32.5±13.4	1.13	(F = 0.80; ddl = 135; p = 0.373>0.05); NS
16	44 (♀); 93 (♂)	28.7±12.3	32.8±12.7	1.07	(F = 0.00; ddl = 135; p = 0.974>0.05); NS
16½	21 (♀); 78 (♂)	32.0±11.8	32.9±11.4	0.93	(F = 0.06; ddl = 097; p = 0.802>0.05); NS
17	17 (♀); 64 (♂)	33.0±12.0	31.8±13.1	1.19	(F = 1.05; ddl = 079; p = 0.310>0.05); NS
17½	08 (♀); 44 (♂)	32.4±13.6	36.3±12.0	0.78	(F = 0.54; ddl = 050; p = 0.467>0.05); NS
12 to 17.5	454 (♀); 723 (♂)	29.68±12.5	29.87±13.2	1.12	(F = 4.10; ddl = 1175; p = 0.43>0.05); NS

NS: No statistically significant differences \*Differences statistically significant at p<0.05

Secondly, the difference between boys and girls is 0.01 d, equivalent to 0.15 IQ points, however, we note that no sex differences in the means of SPM scores between girls and boys (12-17.5 years) (u = 162070; p = 0.72>0.05). As for variability, the VR for the all subjects was 1.12, showing that boys had slightly variability than girls; yet the Levene's test indicate the homogeneity of variances of SPM scores between girls and boy for all age groups except the age group 13 years (p<0.05), in which boys show more variability in intelligence.

Many authors report the same assertion about means of intelligence. An early statement of the absence of a sex differences in average intelligence was made by Burt and Moore (1912), Terman (1916), Spearman (1923), Cattell (1971), Eysenck *et al.* (1981), Brody (1992), Herrnstein and Murray (1994), Mackintosh (1996), Jensen (1998), Halpern (2000), Bartholomew (2004) and

Anderson (2004). Recently, numerous scholars contend the same conclusion: “Men are more intelligent than women are not supported by experimental data” (Hines, 2007), “General intelligence does not differ between men and women” (Haier, 2007), “There is no difference in intelligence between males and females, the sexes are equally smart” (Halpern, 2007), “Men and women have equal cognitive capacity” (Spelke and Grace, 2007). Newly Dapo and Kolenovic-Dapo (2012) found that At ages of 12.6 and 16 the effect sizes of sex difference in performance on tests of fluid intelligence were small.

Numerous scholars reached the same result that no sex differences in variability of intelligence. Terman (1916) found no difference between boys and girls in variability on the basis of his American standardization sample of the Stanford-Binet test on approximately 1000 subject (4-16 year olds), also Harnqvist (1997) found no male-female difference on a latent g-factor between the ages of 11 and 16; Irwing and Lynn (2005) have reported that there was no sex difference in variability in a meta-analysis of 22 studies of sex differences among university students versus nine others studies of sex difference in variability on the Progressive Matrices; Reynolds *et al.* (2008) failed to find greater male variability; several studies in Muslim countries reported no difference in standard deviations between male and female on SPM; in the United Arab Emirates (Khaleefa and Lynn, 2008b), Libya (Lynn *et al.*, 2008) and Syria (Khaleefa and Lynn, 2008a).

Thirdly we observe that the SPM scores increase by age groups and girls are slightly greater than males in mean of SPM scores until the age of 15 years, from the age of 16 years boys begin slightly greater than girls; this assertion was agree with a meta-analysis carried out about sex differences on the SPM by Lynn and Irwing (2004), also has been confirmed by Colom and Lynn (2004), Nyborg (2003, 2005), Meisenberg (2009) and Dapo and Kolenovic-Dapo (2012); the results obtained could be interpreted by a different rate of maturation between boys and girls, Lynn and Kanazawa (2011), explained by the earlier puberty which is accompanied by earlier brain maturation among girls and the boys catch up maturity brain after the age of 15 years, this observation is in agreement with Richard Lynn’s developmental theory, which proposes that intellectual maturation proceeds in parallel with physical maturation (Lynn, 1994, 1998, 1999).

## **CONCLUSION**

No sex differences in means and variance of general intelligence between girls and boys (12.5-17.5 years); girls are slightly greater than males in mean of SPM scores until the age of 15 years, from the age of 16 years boys begin slightly greater than girls.

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