Iodine Status of Primary School Children in Different Egyptian Environments

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ABSTRACT

Background: iodine deficiency is the main cause of potentially preventable mental retardation in childhood. It is still prevalent in large parts of the world. Mild iodine deficiency can affect cognitive development of the child. Aim of study investigated iodine status of primary school children and consumption of iodized salt. **Subjects and methods**: this study included 2105 households, urine analysis for 1879 primary school children aged (6 - 12 years) from urban and rural sites (975 and 904), seven governorates in Egypt (Behera, Menoufia, Dakahlia, Beni Suif, Minya, Wadi Jedid and South Sinai). **Results**: showed that more than 50% of household used iodized salt. In addition, they were adding iodized salt (65.8%) during the process of cooking food. Beni Suif recorded the highest prevalence of mild iodine deficiency in both urban and rural sites. **Conclusion**: iodized salt program in the seven governments faces some problem/barriers for use of iodized salt at household level. Government has required the use of iodized salt in processed foods. **Recommendation**: Surveillance systems need to be strengthened to monitor both low and excessive intakes of iodine to improve the iodine nutritional status of the population without risks of iodine excess or deficiency.

Keywords: urinary iodine concentrations (UIC) – primary school children - iodized salt consumption

INTRODUCTION

Iodine is an important micronutrient required for human nutrition. Iodine deficiency disorders (IDD) refer to a complex clinical and sub-clinical disorder caused by the lack of adequate dietary iodine which is common cause of preventable brain damage, mental retardation, stunted growth and development in children. Goiter is the most common clinical manifestation of Iodine deficiency in children and adults.[1]

Iodine is essential for the synthesis of thyroid hormones. Iodine deficiency can affect human health in different ways, and is commonly referred to as IDD. These range from defective development of the central nervous system during the fetal–neonatal life, to goiter in the adult.[2] Synthesis and release of thyroxin (T4) and triiodothyronine (T3) are stimulated by the pituitary's release of thyroid-stimulating hormone (TSH or thyrotrophic). When T3 and T4 concentrations are low TSH production is increased, and, as the opposite is also true, this creates a negative feedback loop between the hypothalamus, pituitary and thyroid.[3]

Iodine deficiency affects nearly 2 billion people globally and is easily preventable with the use of iodized salt in the diet.[4] Iodine deficiency during pregnancy is associated with increased rates of stillbirths, spontaneous abortions, and congenital anomalies [5] and is the leading worldwide preventable cause of intellectual impairment in children.[6] A global survey of iodine sufficiency in 2011 identified that although there were some improvement worldwide in iodine sufficiency, 29.8% of school aged children still had insufficient iodine intake. [7]

Owing to the iodine fortification of salt in many countries, severe iodine deficiency is a rare condition. Nevertheless; mild-to-moderate iodine deficiency is still considered a major public health concern, even in some developed countries. [8]

The appropriate level of iodine supplementation in dietary supplements will depend on the individual consumption of the iodized food (salt, water, bread etc.), the degree of iodine deficiency in the area and the loss of iodine from producer to consumer. All these factors will be different in different countries, and for example, levels of salt iodization have varied substantially between countries and over time. [9]

Also, the response to supplemental iodine may be reduced by other factors in the environment, such as consumption of specific goitrogenic foods (for example, cassava (manioc), Soybeans and its products, Pine nuts, Peanuts, Flax seed Millet, Strawberries, Pears, Peaches, Spinach and Sweet potatoes), and

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deficiency of other trace elements in the diet, such as selenium [10] or iron.[11]

Iodized salt, iodized bread, iodized water, iodine tablets and iodized oil (given orally or by injection) are commonly used for preventing iodine deficiency disorders. Iodized salt is considered the most appropriate means of iodine supplementation. Iodine supplements in the form of tablets or injections can be dosed more accurately than food supplements, but some of these interventions require personal contact with the population to be treated (i.e. a large administrative effort) and methods providing intermittent doses of iodine provide uneven levels of iodine during the months between administrations. [9]

In Egypt, iodized salt program has been implemented since 1996, and the Egyptian National Salt Companies were iodizing salt for almost 90% of total salt production. Demographic Health Survey (DHS), [12] in the 2008, revealed that overall, 79% of Egyptian households had salt were using adequately iodized salt.

Aim of study investigated iodine status of primary school children and consumption of iodized salt.

SUBJECTS AND METHODS

Subjects

This study included 2105 households, urine analysis for 1879 primary school children aged (6 - 12 years) from urban and rural sites (975 and 904), seven governorates in Egypt (Behera, Menoufia, Dakahlia) as lower Egypt, (Beni Suif, Minya) as upper Egypt and (Wadi Jedid and South Sinai) as frontier governorates. Results of present study were in a project concluded by National Nutrition Institute / Ministry of Health, (NNI / MOH) in collaboration with UNICEF.

Sampling design

Households survey

Two stage cluster sampling technique was used. Thirty cluster (where the cluster is a city or village) were selected from each governorate from all its districts or directorates based on the technique "population size" (PPS) representing both urban & rural areas households enrolled in the study.

Study settings

1- Households – based survey from seven governorates (Bahera, Menoufia, Dakahlia, Beni Suif, Minya, Wadi Jedid and South Sinai).

2- Primary school (governmental, private, Al-Azhar).

Methods

Survey questionnaire form used was prepared, coded and tested to include:

. Identifications data.

. Interview of the mother’s child to cover her knowledge, attitude and practice (KAP) study.

. Instant testing (by test kits) for presence of iodine in salt samples was taken from each household.

. Examination of salt quality for its particle size, humidity and impurities.

Analysis of urinary iodine

Collection of casual urine samples in sterile cups from primary school children for iodine content analysis. It was carried out for school children (6-12 y) of the nearest school in the neighborhood of the studied household for at least 30 samples in the site (urban and rural) and a total of 1879 urine samples were collected. Urinary iodine was determined using calorimetric method. [13] Urinary iodine levels were categorized according to epidemiologic criteria for assessing iodine nutrition based on media urinary iodine concentrations UIC. [14]

The world health organization WHO recommends a daily intake of iodine is 120 µg for schoolchildren (6-12 years). In addition, the epidemiological criteria for assessing iodine nutrition based on median urinary iodine UI concentrations in school-age children (table1).

Statistical analysis

Statistical analysis of the results by using computer program statistical package for social sciences (SPSS), independent descriptive statistics in the form of frequencies and percentages for qualitative variables, F-test and one-way analysis of variance (ANOVA) were used, the difference was considered significant at P-value < 0.05. [15]

RESULTS

Tables (2 and 3) are a description of characteristics of the sample

Data in table **(4)** were evidenced that iodine deficiency (ID) (< 100 µg/L) is present among 10 % of the studied primary school children in seven governorates. There was one child in Menoufia and another in Beni Suif who had moderate iodine deficiency > 20 and < 50 µg/L. The highest percent of ID was recorded in Beni Suif but the lowest percent was showed in Menoufia and South Sinai. There was significant difference (P=0.00) between governorates in prevalence of mild iodine deficiency (50- 99.9 µg/L).

Iodine adequate (100-199 µg/L) was present among 53.9 % of the children in all governorates. Minya governorate had the highest percent 19.5 % while Menoufia was recorded the lowest percent 11.6%.

Iodine more than adequate (200-299 µg/L) was noted in 24.2 % of studied samples. South Sinai was distinct with the highest percentage (19.8 %) however Beni Suif had the lowest percentage (12.1 %).

Iodine excessive (≥ 300µg/L) was present among 12% of all samples. Menoufia was recorded the highest prevalence (24.9 %) of iodine excessive while Minya had the lowest percentage (3.6%).

Table **(5)** clarified that the prevalence of iodine deficiency was higher in rural than urban sites. There was significant difference (P< 0.05) between governorates (U/R) in prevalence of iodine deficiency. South Sinai did not show any case had iodine deficiency in rural site but in the urban area it was recorded 11.0% from total sample studied. Beni Suif recorded the highest prevalence of mild iodine deficiency in both urban and rural sites among studied governorates. Except South Sinai governorate in rural, Menoufia had the lowest prevalence of mild iodine deficiency in both urban and rural areas among studied governorates.

Iodine adequate (100-199 µg/L) was presents among 28.7 % of the children in urban area but it was 25.2% in rural site. Minya governorate had the highest prevalence of iodine adequate in both urban and rural areas among studied governorates. Behera governorate had the lowest prevalence of iodine adequate in urban area while Dakahlia in rural site.

Prevalence iodine more than adequate was enhance in urban than in rural. South Sinai governorate had the highest prevalence of iodine more than adequate in both urban and rural areas among studied governorates. Beni Suif governorate had the lowest prevalence of iodine more than adequate in urban site, while Minya governorate was in rural area.

Prevalence of iodine excessive was approximate percent (6.0, 5.96%) in urban and rural areas respectively. There was significant difference (P< 0.05) between governorates in prevalence of excessive iodine. Prevalence of iodine excessive in urban was clarified in Behera governorate but it was in rural area for South Sinai.

DISCUSSION

Most of the iodine absorbed by the body is eventually excreted in the urine. Several indicators are used to assess the iodine status of a population: thyroid size by palpation and/or by ultrasonography, urinary iodine (UI) and the blood constituents, TSH or thyroxin (T4) and triiodothyronine (T3). [6] The median UIC was the best indicator to use in population surveys to assess the iodine nutrition because it is highly sensitive to recent changes in iodine intake and UIC is the most reliable indicator of IDD, showed mild-to-moderate iodine deficiency. [16]

Findings were appeared in the present study the highest percent of ID was recorded in Beni Suif governorate due to it one of governorates in high usage salt with no iodine, and the lowest governorate salt iodine level was ≥ 15ppm regarding to table (1). In addition results were showed improve in status ID in all governorates study. Iodine deficiency was considered mild deficiency (≥50 µg /L) except two cases had less than moderate iodine deficiency 50µg/L. South Sinai did not show any case had iodine deficiency in rural. This is due to the good practices in the use of salt packed (avoid exposure to moisture, light, and contaminants) and most household used salt adequate iodized (≥ 15 ppm).

This improvement compare with studies done by **El-Sayed *et al.*** [17] reported a median urinary iodine concentration of 5.0µg/L in goiter's children in Upper Egypt. **Yamamah *et al.***[18] studied Thyroid volumes and iodine status of Egyptian school children in South Sinai. They found that median urinary iodine concentration (UIC) of the study was 150 µg/L, showing adequacy of iodine nutrition; 11.5% of the studied group had UIC below 50 µg/L and 31% had UIC below 100 µg/L. It has agreed with the study in the Islamic Republic of Iran, when **Azizi, *et al.***[19] were observed that median urinary iodine concentration was 76µg/L; this increased to 185µg/L after iodine supplementation. **Erdogan *et al.***[20] found that it took 10 years after the introduction of iodized salt for the prevalence of goitre to decrease from 25% to 1% in Turkish children. However, in a randomized trial conducted in 2007 of iodine-deficient New Zealand children living in Dunedin, daily supplementation with 150 mg iodine for 7 months increased UIC from 62 to 145µg/L. [21]

Data in the present study clarified that 10% from studied samples had mild deficiency of iodine; 24.2 % of the value above 200 µg/L and 12% over 300µg/L. This result not compatible with searched by **Djokomoeljanto *et al.*[22]** who found that the urinary iodine excretion rates of Indonesia children recorded the median urinary iodine value (81.0 µg/L), with 58.3% of the values below 100 µg/L (mild to severe deficiency) and only 14.7% of the values above 200 µg/L. While **Meng, *et al.*[23]**found that approximately 40.03% of Chinese children had a UIC value standing at over 300µg/L.

Appearance of existence more adequate and excessive iodine level in present study, may be due to increase consumption of different source of iodine with iodized salt and different food as a rich source of iodine.

With reference to school location – urban versus rural residence-better levels of UIC were estimated in urban areas compared to that of rural ones. The present study showed that prevalence of iodine adequate in rural areas was 25.2 % compared to that of urban which was 28.7 % this also confirm with that of the national iodine nutrition survey by NNI 2006/2007 which revealed that rural ID prevalence was 24% compared to that of urban which was 11.2 %.[24] This can be clearly explained by the fact that socioeconomic score is usually higher in urban than rural sites. Added to that utilization unionized salt is usually high in rural area which depended mainly on use of that salt in pickling, salting of cheese and bread making due mainly to its low price, as evidenced by findings of present study.

South Sinai governorate had the highest prevalence of iodine more than adequate in both urban and rural areas among studied governorates. Also South Sinai governorate has the largest proportion of prevalence excessive iodine level in rural area. It may be due to fisheries as a result of the extension of governorate on the Gulf of Suez and Aqaba, also presence palm trees, which rich in iodine and iron with continue iodized salt programs.

Andersson *et al.*[7] studied assess global and regional iodine status of 2011 and compare it to previous WHO estimates from 2003 and 2007. They found that in 2011, iodine intake is inadequate in 32 countries, adequate in 69, more than adequate in 36, and excessive in 11 countries. Of the 32 countries with iodine deficiency, 9 are classified as moderately deficient and 23 as mildly deficient. No country is categorized as severely deficient. Since 2003 and 2007, the number of countries with insufficient intake has decreased; at the same time, the number of countries with adequate intake enhanced and countries with more-than-adequate and excessive iodine intake increased.

CONCLUSION

Must be based on study results only

Iodine deficiency is a public health problem of mild severity in the school children aged 6-12 years which would study in different governorates schools. The present study clarified that 10% from studied samples had mild deficiency of iodine; 24.2 % of the value above 200 µg/L and 12% over 300µg/L. Household use of adequately iodized salt is still lacking much behind the recommended percent (more than 90% of households use adequately iodized salt) as an indicator on sustainable elimination of IDD.

RECOMMENDATIONS

Based on findings and conclusions of the present study, lack of awareness at all levels is still one of the main obstacles in attaining sustained elimination of ID. So it is highly important to increase the awareness of the community. Information and education activities of the population about the importance of buying and using iodized salt in the households should be intensified. Surveillance systems need to be strengthened to monitor both low and excessive intakes of iodine to improve the iodine nutritional status of the population without risks of iodine excess or deficiency.

REFERENCES

1. **Singh G, Kaur G, Mengi V, and Raina S K (2013):** Differentials in Prevalence of Goitre among School Children (6-12 Years of Age) in Rural North-West, India Public Health Research, 3(3): 79-84
2. **Emilio F, Massimo T, and Paolo V (2014):** Influence of iodization programmes on the epidemiology of nodular goiter. Best Practice & Research Clinical Endocrinology & Metabolism, Volume 28, Issue 4, Pages 577–588.
3. **Suzuki S, Shingematsu S, Inada H, Takei M, Takeda T, and Komastsu M (2011):** Pituitary resistance to thyroid hormones: pathophysiology and therapeutic options. Endocrine, 40(3):366–71.

4. **Zmmermann MB (2009):** Iodine deficiency. Endocr Rev., 30:376–408.

5. **Hetzel BS (1983):** Iodine deficiency disorders (IDD) and their eradication. Lancet, 2:1126–1129.

6. **World health Organization (WHO) (2004)**: Iodine Status worldwide: WHO global database on iodine deficiency: Geneva.

7. **Andersson M, Karumbunathan V, and Zimmermann MB (2012):** Global iodine status in 2011 and trends over the past decade. J Nutr., 142:744–750.

8. **Pearce EN, Andersson M, and Zimmermann MB (2013):** Global iodine nutrition: Thyroid, 23:523–8.

9. **Dunn JT (1996):** Seven deadly sins in confronting endemic iodine deficiency, and how to avoid them. Journal of Clinical Endocrinology and Metabolism. 81(4):1332–5.

10. **Köhrle J (1999):** The trace element selenium and the thyroid gland. Biochimie; 81:527–33.

11. **Zimmermann M, Adou P, Torresani T, Zeder C, and Hurrell R (2000):** Persistence of goiter despite oral iodine supplementation in goitrous children with iron deficiency anemia in Côte d'Ivoire. American Journal of Clinical Nutrition, 71:88–93.

12. **Egypt Demographic Health Survey (DHS) (2008):** Cairo, Egypt: Ministry of Health, El-Zanaty and Associates, and Macro International, Characteristics of the Household Population, page:13-22

13. **ICCIDD /UNICEF /WHO (1993):** Dunn JT, Crutchfield HE, Gutekunst R, Dunn AD: Two simple methods for measuring iodine in urine. The Netherlands, ICCIDD.

14. **WHO/UNICEF /ICCIDD (2007**): Assessment of iodine deficiency disorders and monitoring their elimination: A guide for program managers, third edition. Geneva: WHO.

15. **Zar JH (1984):** Biostatisticial analysis. 2thedn. Prencice-Hall, Englewood Cliffs. N.J., pp. 196-198.

16. **WHO, UNICEF, ICCIDD (2001**): Assessment of iodine deficiency disorders and monitoring their elimination: a guide for programme managers. 2nd ed. Geneva: World Health Organization/NHD/01.1

17. El-Sayed N A, Mahfouz A, Nofal L, Ismail H M, Gad A and Abu Zeid H, (1998): Iodine deficiency disorders among school children in Upper Egypt: an epidemiologic study. Journal of tropical pediatrics, 44(5):270–4.

18. Yamamah G A, Kamel AF, Abd-El Dayem S, Hussein AS, and Salama H (2013): Thyroid volumes and iodine status in Egyptian South Sinai schoolchildren. Arch Med Sci 3.

19. Azizi F, Navai L, and Fattahi F (2002): Goiter prevalence, urinary iodine excretion, thyroid function and anti-thyroid function and anti-thyroid antibodies after 12 years of salt iodization in Shahriar, Iran, International journal for vitamin and nutrition research, 72(5):291–5.

17. **20. Erdogan MF, Demir O, Kamel AN, and Erdogan G (2009):** More than a decade of iodine prophylaxis is needed to eradicate goiter among school age children in a modestly iodine-deficient region. J. Thyroid, 19: 265–268.

18. **21. Gordon RC, Rose MC, Skeaff S, Gray AR, Morgan K MD, and Ruffman T (2009):** Iodine supplementation improves cognition in mildly iodine deficient children. Am J Clin Nutr., 90: 1264–1271.

19. **22. Djokomoeljanto R, Setyawan H, Dramaix M, Hadisaputro S, Soehartono T and Delange F (2001):** The ThyroMobil model for standardized evaluation of iodine deficiency disorders control in Indonesia. J. Thyroid, 11(4):365–72.

20. **23. Meng F, Zhao R, Liu P, Liu L, and Liu S (2013):** Assessment of Iodine Status in Children, Adults, Pregnant Women and Lactating Women in Iodine-Replete Areas of China. PLOS ONE | www.plosone.org 1 November 2013 | Volume 8 | Issue 11 | e81294

21. **24. National Nutrition Institute (NNI) (2006-2007):** Evaluation of the effect of social marketing campaign on improving iodized salt and Knowledge increasing consumption. Unpublished report.

Table (1):- Epidemiological criteria for assessing iodine nutrition based on median UI concentrations in school-age children

Median UI (µg/L)	Iodine intake	Iodine nutrition
< 20	insufficient	Severe iodine deficiency
20-49	insufficient	Moderate iodine deficiency
50-99	insufficient	Mild iodine deficiency
100-199	Adequate	Optimal iodine nutrition
200-299	More than adequate	Risk of iodine-induced hyperthyroidism within 5 - 10 years following introduction of iodized salt in susceptible groups
≥300	Excessive	Risk of adverse health consequences (iodine induced hyperthyroidism, auto-immune thyroid diseases)
Source: WHO Global Database on Iodine Deficiency (2001)		

Table (2): Characteristics of the Samples

Characteristics of household															
G	Area	NO.	%	Social status			Distribution sample according to salt iodine level			% of sample according to consumption of salt			% of sample according to adding salt during cooking	
				Low %	Middle%	High%	No-iodine	<15 ppm	≥15 ppm	packed	Un-packed	both	At the start	At the end
Behera	U	150	50	36.0	53.3	10.7	41	17	92	85.7	10.3	4	38.3	61.7
	R	150	50	46.7	48.7	4.7	20	50	80					
	T	300	100	41.3	51	7.7	61	67	172					
Dakahlia	U	161	53.8	18.6	51.6	29.8	23	14	124	69.9	19.7	10.4	36.8	63.8
	R	138	46.2	19.6	53.6	26.8	36	22	80					
	T	299	100	19.1	52.5	28.4	59	36	204					
Menoufia	U	150	49	40.7	44.0	15.3	28	39	83	64.7	19.3	16	39.9	60.1
	R	156	51	32.7	57.7	9.6	11	25	120					
	T	306	100	36.6	51.0	12.4	39	64	203					
Beni Suif	U	149	49.5	28.9	52.3	18.8	33	24	92	88.7	8.6	2.7	31.6	68.4
	R	152	50.5	35.5	56.6	7.9	43	65	44					
	T	301	100	32.2	54.5	13.3	76	89	136					
Minya	U	149	49.8	12.1	53.7	34.2	26	9	114	85.6	10.7	3.7	18.7	81.3
	R	150	50.2	37.3	48.7	14.0	45	43	62					
	T	299	100	24.7	51.2	24.1	71	52	176					
Wadi Jedid	U	151	50.3	31.1	47.0	21.9	4	29	118	98.6	0.7	0.7	40	60
	R	149	49.7	43.6	42.3	14.1	1	13	135					
	T	300	100	37.3	44.7	18.0	5	42	253					
South of Sinai	U	138	46	9.4	42.0	48.6	26	16	96	97.3	0.7	2	33.7	66.3
	R	162	54	31.5	64.8	3.7	60	29	73					
	T	300	100	21.3	54.3	24.3	86	45	169					
total	U	1048	49.8	--	--	--	181	148	719	88.1	10.1	5.8	34.2	65.8
	R	1057	50.2				216	247	594					
	T	2105	100				397	395	1313					

U: Urban R: Rural T: total G: governorates χ^2 for urban= 111.3 χ^2 for rural = 76.3 *P*= 0.00

Table (3): Characteristics of primary school Children aged 6-12 years

Governorates / Area	Number	Behera	Dakahlia	Menoufia	Beni Suif	Minya	Wadi Jedid	South of Sinai	Total
Urban	No.	138	128	136	136	142	144	151	975
Rural	No.	133	98	114	135	142	135	147	904
Total	No.	271	226	250	271	284	279	298	1879

Table (4): iodine status of studied samples based on median urinary iodine concentrations (µg/L)

Urinary Iodine level (µg/L)	statistic	Governorates								
		Behera	Dakahlia	Menoufia	Beni Suif	Minya	Wadi Jedid	South Sinai	Total	% of Total samples
Iodine Deficiency <100	No.	37	33	10	53	17	28	10	188	10
	%	19.7	17.6	5.3	28.2	9.0	14.9	5.3	100	
Iodine adequate 100- 199	No.	124	119	117	136	197	159	160	1012	53.9
	%	12.3	11.8	11.6	13.4	19.5	15.7	15.8	100	
Iodine more than adequate 200- 299	No.	59	57	67	55	62	64	90	454	24.2
	%	13.0	12.6	14.8	12.1	13.7	14.1	19.8	100	
Iodine excessive ≥ 300	No.	51	17	56	27	8	28	38	225	12
	%	22.7	7.6	24.9	12	3.6	12.4	16.9	100	
Total	No.	271	226	250	271	284	279	298	1879	100

Significant difference between governorates $P = 0.000$

Table (5): iodine status of studied samples by urban versus rural based on median urinary Iodine concentrations (µg/L)

Urinary Iodine level (µg/L)	Area	statistic	Governorate							
			Behera	Dakahlia	Menoufia	Beni Suef	Minya	Wadi Jedid	South Sinai	Total
Iodine deficiency < 100	U	No.	11	18	5	28	6	13	10	91
		% within Govern.	4.1	8.0	2.0	10.3	2.1	4.7	3.4	4.8
	R	No.	26	15	5	25	11	15	0	97
		% within Govern.	10.0	6.6	2.0	9.2	3.9	5.4	0	5.1
Iodine adequate 100- 199	U	No.	64	74	68	66	93	84	90	539
		% within Govern.	23.6	32.7	27.2	24.4	32.8	30.1	30.2	28.7
	R	No.	60	45	49	70	104	75	70	473
		% within Govern.	22.1	19.9	19.6	25.8	36.6	26.9	23.5	25.2
Iodine More than adequate 200- 299	U	No.	33	28	35	25	38	30	44	233
		% within Govern.	12.2	12.4	14.0	9.2	13.4	10.8	14.8	12.4
	R	No.	26	29	32	30	24	34	46	221
		% within Govern.	9.6	12.8	12.8	11.1	8.5	12.2	15.4	11.8
Iodine excessive ≥ 300	U	No.	30	8	28	18	5	17	7	113
		% within Govern.	13.6	3.5	11.2	6.6	1.8	6.1	2.3	6.0
	R	No.	21	9	28	9	3	11	31	112
		% within Govern.	7.7	4.0	11.2	3.3	1.1	3.9	10.4	5.96
Total		No.	271	226	250	271	284	279	298	1879
		% Govern.	100	100	100	100	100	100	100	100

Significant difference between governorates $P = 0.000$