

Studies on Twins

I. Typhoid Favours Cotwins¹

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Infectious process in both members of a MZ pair suggests the existence of a heredity pattern (Gedda, 1961). But, when one member of a MZ pair suffers from a disease and the other remains normal, chances of such disease to be "hereditary" are negligible. On the contrary, the normal cotwin acts as control (Dencker, 1958), providing excellent opportunities to study the after effects of the disease under consideration.

The present paper, dealing with 56 MZ pairs, reviews the after effects of typhoid incidence on the anthropometric, mental and physical traits of 34 cotwins (who did not have any disease other than typhoid), their partners acting as control.

Polysymptomatic diagnosis to ascertain the zygosity of twins based on the principles of finger ridge counts (Henry, 1901; Stocks, 1930; and others) and on concordance/discordance of many physical and mental traits (Newman *et al.*, 1937) has been one of the commonest methods of studying twins. Inouye (1956) investigated 70 traits in teeth, skeletal system and hair to be more useful for diagnosis than those in pigment and soft organs in Japanese twins. Penrose (1954, and earlier) used position of the palmar axial triradius and Smith & Penrose (1955) emphasized on blood groups, for the zygosity diagnosis of twins.

In Sweden, U.S.A. and Italy zygosity has also been ascertained by the question "When growing up were you as like as two peas in a pod or of a family likeness only?". More than 95% of the twins who answered the question "like two peas in a pod" were correctly identified as MZ on the basis of blood and serum grouping. An excellent review of all these methods has recently appeared (W.H.O., 1966).

Owing to the lack of facilities serological tests have been ignored and only 12 anthropometric, 7 mental and 8 physical traits have been investigated during 1964-66 from Indore, Agar, Gwalior, Datia und Ujjain. Questionnaires sent in early 1964 included names, age, address, sex, school grade, test results, personality, behaviour, record of physical development, medical history and social relationships of twins. Interestingly, it also included a question "were cotwins exactly alike at the age of four and thereafter?". When cotwins were reported to have identical phenotype and

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Tab. 1. Relative chances in favour of DZ twin pairs according to finger ridge counts

Differences between counts	N. of pairs		Percentage of pairs		Relative chances in favour of DZ pair d/m
	MZ twins	Same-sexed sibs	MZ twins (m)	Sibs (d)	
0-2	2	0	3.57	0	0
3-5	4	0	7.14	0	0
6-8	5	3	8.92	2.30	0.20
9-11	11	8	19.64	6.15	0.30
12-14	13	7	23.21	5.38	0.23
15-17	10	9	17.85	6.92	0.38
18-20	4	14	7.14	10.76	1.50
21-23	3	18	5.35	13.84	2.58
24-26	2	20	3.57	15.38	4.32
27-29	1	25	1.78	19.23	10.80
30-32	1	26	1.78	20.00	11.10
Total	56	130	99.95	99.96	

other characters at an age, and later one cotwin became discordant for a typhoid incidence, the case was seriously taken. Previous and recent photographs, medical reports, X rays, nature and duration of illness evidenced by prescriptions of doctors were obtained with the cooperation of parents and their relatives.

Finger prints (right digit ulnar loop) were made on glossy paper with the help of pad ink or printing ink. Sometimes, due to ink running or thickening of the ridge, the "islands" surrounding the 'core' ridge appeared as a bulging. To avoid this anomaly glycerin was applied on the inking pad. Four impressions were made in horizontal straight line of one cotwin and similarly 4 of the other partner on the same paper. In ridge counting two terminal points (inner and outer terminus) were excluded from the count (Henry, 1901). Incomplete ridges not meeting the drawn line in between the inner and outer terminus were also excluded from the count. The ridge counts were made with the help of a pointer and a magnifying glass. The differences in finger ridge counts between cotwins of 56 MZ pairs and 130 same sexed sibs are recorded in Tab. 1. Only same-sexed pairs are used in order to eliminate slight constitutional differences due to sex. The difference between total ridge counts of MZ pairs and sib pairs have been grouped and the percentage of each series falling in the groups is shown in the right hand column of Tab. 1.

Upper half of Tab. 1 has the distribution of 35 pairs (17 normal, 5 'both' and 10 'one' of Tab. 2) showing the differences between the finger tip counts (2-14). The lower half shows 21 pairs where one member of each pair had typhoid incidence and showed greater differences in counts (15-32).

Tab. 2. Mean anthropometric differences among co-twins of 56 MZ twins with or without typhoid incidence

Age group (years)	Member suffered	N. of pairs	Height (cm)		Length (cm)				Breadth (cm)		Head circumference (cm)	Body weight (kg) **	Chest expansion (cm)
			Standing	Sitting	Hands	Legs	Nose	Ear	Eye brows	Lips			
6-10	None	5	—	—	0.2 ± .1	0.3 ± .1	—	—	—	—	.3 ± .0	.5 ± .0	—
	One	7	.5 ± .1	.2 ± .1	.2 ± .1	.4 ± .1	.1 ± 0	.1 ± .0	.1 ± 0	.1 ± 0	.5 ± .1	1.8	.2
	Both	2	.2	.1	.1	.3 ± .1	—	—	—	—	.2 ± .1	1.5	.2
11-15	None	4	1.0 ± .5	.5 ± .1	.3 ± .1	.3 ± .1	.2	.2	.2	.2 ± .1	.4 ± .1	.5	.3
	One	12	2 ± .5	1 ± .6	.8 ± .2	1.5	.3 ± .1	.4 ± .1	.4	.3 ± .1	.5	.6 ± .1	.4 ± .1
	Both	3	1.2 ± .4	1.4	.6 ± .1	1.5	.2 ± .1	.2 ± .1	.2	.3 ± .1	.3	.4 ± .1	*
16-20	None	3	2 ± .3	1 ± .1	.7 ± .1	1.2	.2 ± .1	.3	.2	.3	2 ± .1	3 ± .1	2 ± .5
	One	5	5 ± .8	4 ± .1	2 ± .5	2 ± .5	.3 ± 0	.4	.25	.3	2 ± .1	3	2 ± .5
	Both	—	—	—	—	—	—	—	—	—	—	—	—
21-25	None	2	2.5 ± .1	1.5 ± .1	.8 ± .2	1 ± .8	.2	.2	.2	.2	3 ± .5	2 ± .5	2 ± .5
	One	8	5 ± .1	4 ± .5	1.5 ± .5	2	.5 ± .1	.3 ± .1	.3	.3	4 ± .8	3 ± .8	4 ± .5
	Both	—	—	—	—	—	—	—	—	—	—	—	—
26-30	None	3	2.5	1.5	1 ± .3	2 ± .5	.3 ± .1	.2	.3 ± .1	.3 ± .1	3 ± .5	2 ± .2	2.5 ± .5
	One	2	4.6 ± .5	3.5 ± .1	1.5 ± .2	2 ± .1	.5 ± .1	.5 ± .1	.5	.5 ± .1	5 ± .5	3 ± .5	4 ± .1
	Both	—	—	—	—	—	—	—	—	—	—	—	—

* Incomplete ** 1 kilo = 2.04 lbs.

Other anthropometric traits shown in Tab. 2 were measured by a steel tap, but body weight, by weighing machine. Each of the five age groups is divided in three columns, 'none', 'one' and 'both' indicating the number of cotwins of a pair suffered from typhoid and total number of such twin pairs falling in the age group.

In the first age group, 5 pairs in column 'none' do not differ in traits other than length of hands, head circumference and body weight. In column 'one' of the same age group cotwins show remarkable differences in measurements. Differences from 0.1 cm to 0.5 cm are significant. The column 'both' does not indicate any difference in length of nose and ears and breadth of eyebrows and lips. Although differences do exist in each column of all age groups among cotwins, however, it is evident from Tab. 2 that column 'one' of each age group tends to show greater differences among its cotwins. Increase in standing and sitting heights and length of hands and legs ranging up to 3 cm and 1.3, - .8 cm respectively in the third age group (16-20), particularly, is of special significance.

Mental aptitude and general ability of cotwins were judged on the following points.

I. Nature: Mild, preevish or aggressive; shy or frank.

II. Tendency: Religious, normal or criminal (Stern, 1960).

III. General liking: Taste of food; choice of clothes, books and friends; social activities and general pattern of routine.

IV. Sports: Smart or inactive; type of sports, indoor or outdoor; prefers light or vigorous exercise; medals & prizes (Gedda, 1960).

V. Habits: Smoker or nonsmoker; habitual of drugs or drinks or otherwise (Kaig, 1958; Friberg *et al.*, 1959).

VI. Responsibility: Dutiful, careless or carefree; socially amiable or attached deeply to home affairs or otherwise.

VII. Intelligence: Studious or dull (parental report); talkative or calm; having inquisitiveness to grasp things or not; understanding power, position in his class or group; active or otherwise in debates and other curricular activities like national cadet corps, etc. (evidenced by testimonials).

These tests were never performed and recorded in the presence of both cotwins.

For mental traits enumerated in Tab. 3, only three pairs are discordant for sports and responsibility in column 'none', one pair discordant in habits and one in intelligence. However, in column 'one' discordance has become a rule rather than exception. Concordance rates ascertained in terms of affected individuals, not in terms of pairs (W.H.O., 1966) reveal the downfall due to typhoid incidence. Rate of concordance for tendency has fallen from 100% to 52% (column 'one') for sports, from 90.3% to 34% respectively. Rate of concordance in column 'both' is 88.8% for all traits other than habit (75%). General downfall in rates of concordance is suggestive of influence of typhoid incidence on these mental traits of cotwins.

Zygotyposity ascertained on the degree of similarity in general appearance, hair, eyes, skin and ears have been proved to be of high validity. Inouye (1956) mentioned "If a same-sexed twin is concordant in seven traits the probability to be MZ is 93.2%".



Fig. 1. Joglekar sister (4) like 'two peas in a pod'.
Reeta suffered from typhoid disease at the age of 12



Fig. 2. Joglekar sisters (16). Reeta (right) after
the typhoid incidence. The discordance in certain
anthropometric, physical and mental traits is
recorded



Fig. 3. Mainer sisters, also from Indore, normal twin pair, looking like 'two peas in a pod'

Tab. 3. Concordance and discordance due to typhoid incidence on mental traits among 56 MZ twins

Members suffered	N. of pairs	Nature		Tendency		General liking		Sports		Habits		Responsibility		Intelligence	
		++	+-	++	+-	++	+-	++	+-	++	+-	++	+-	++	+-
None	17	17	—	17	—	17	—	15	2	16	1	16	1	16	1
One	34	30	4	22	12	8	26	20	14	8	26	8	26	7	27
Both	5	4	1	4	1	4	1	4	1	3	2	4	1	4	1

Tab. 4. Concordance and discordance due to typhoid incidence on physical traits among 56 MZ twins

Members suffered	N. of pairs	Colour						Shape						Type		Voice sound	
		Eyes		Skin		Hair		Eyes		Lips		Ear		Hair			
		++	+-	++	+-	++	+-	++	+-	++	+-	++	+-	++	+-	++	+-
None	17	17	—	16	1	17	—	17	—	15	2	17	—	17	—	15	2
One	34	32	2	30	4	34	—	27	7	30	4	34	—	32	2	20	14
Both	5	5	—	5	—	5	—	5	—	5	—	5	—	5	—	4	1

Concordance and discordance for present cases (Tab. 4) was decided on these outlines: (1) Colour eyes: black or with brownish appearance, rarely blue; skin: fair, medium or dark; hair: black, faint black or brownish (not due to chemical); (2) shape of eyes, lips, and ear, lobes attached or free; (3) type of hair: curly or smooth; (4) voice sound (on hearing them separately). Significant decrease in rates of concordance in column 'one' for all traits other than colour of hair and shape of ear further suggests the influence of typhoid incidence on phenotypic expressions.

There has been concordance for phenotypic traits (Fig. 1) before the typhoid incidence, but discordance appeared after it (Fig. 2). Greater degree of concordance is still maintained in normal twins (Fig. 3).

Summary

The experimental cotwin control method by means of 34 MZ pairs, of which only one cotwin of each pair suffered from typhoid disease, offered excellent opportunities to study the after effects of typhoid incidence on the anthropometric, mental and physical traits of individuals. Comparison among 56 MZ pairs reveals that typhoid brings out certain significant changes in these traits.

Increase of intelligence has already been shown, due to increased quantity of RNA. Whether or not typhoid incidence after a period of approximately 7 months influences the rapid synthesis of RNA would be a good field of biochemical investigation of immunogenetical interest.

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* Not seen in original.

RIASSUNTO

Il metodo sperimentale del controllo cogemellare applicato su 34 coppie gemellari di cui un solo gemello di ciascuna coppia affetto da tifo, ha offerto l'occasione per studiare l'effetto della malattia sui caratteri antropometrici e psicofisici degli individui. Lo studio di 56 coppie MZ indica che il tifo comporta alcune variazioni significative di tali caratteri. È già stato dimostrato un aumento dell'intelligenza, a causa di una maggior quantità di RNA. Accertare se effettivamente il tifo, dopo un periodo di 7 mesi, influisca sulla sintesi dell'RNA, sarebbe un interessante ramo della ricerca biochimica di interesse immunogenetico.

RÉSUMÉ

La méthode expérimentale du contrôle gé-mellaire, effectué moyennant 34 couples MZ — un seul membre de chaque couple étant atteint de maladie typhoïde — a offert d'excellentes opportunités pour étudier l'effet de la maladie typhoïde sur les caractères anthropométriques mentaux et physiques. L'étude de 56 couples MZ révèle des changements significatifs. Une augmentation de l'intelligence, en raison d'une augmentation de la quantité d'RNA a déjà été démontré. Il serait intéressant au point de vue immunogénétique de conduire une recherche biochimique visant à découvrir si, après une période d'environ 7 mois, la maladie typhoïde influence réellement la synthèse de l'RNA.

ZUSAMMENFASSUNG

Es wurden 34 Zwillingspaare untersucht, von denen immer nur ein Parling an Typhus erkrankt war, um die Wirkung dieser Krankheit auf die anthropometrischen und psychisch-physischen Merkmale der Patienten festzustellen. Bei einer Reihe von 56 EZ-Paaren zeigte es sich, dass einige Merkmale durch Typhus wesentliche Veränderungen erfahren. Es wurde bereits ein Ansteigen der Intelligenz bewiesen, das durch eine erhöhte RNS-Menge bedingt wird. Es wäre ein interessanter Zweig der immungenetischen biochemischen Forschung festzustellen, ob der Typhus in der Tat nach Ablauf von 7 Monaten einen Einfluss auf die RNS-Synthese ausübt.