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Anorexia Nervosa: A Study of 34 Twin Pairs and One Set of Triplets

A. J. HOLLAND, A. HALL, R. MURRAY, G. F. M. RUSSELL and A. H. CRISP

Summary: In a collaborative study between St George's and the Maudsley Hospitals, 34 pairs of twins and one set of triplets were identified in which the proband had anorexia nervosa. The diagnosis was based on standard criteria and zygosity was established by blood group analysis or by use of the physical resemblance questionnaire. In the 30 female twin pairs, 9/16 of the monozygotic (MZ) and 1/14 of the dizygotic (DZ) pairs were concordant for anorexia nervosa. Three of the non-anorexia co-twins had other psychiatric illnesses, and two had minor eating disorders. None of the male co-twins had anorexia nervosa.

The aetiology of anorexia nervosa remains a matter of debate. The incidence appears to be increasing (Jones *et al*, 1980) and a survey of teenage schoolgirls found that 1 in 200 were suffering from a clear-cut form of the disorder (Crisp *et al*, 1976). The illness remains associated with a significant morbidity and mortality (Morgan & Russell, 1975; Hsu *et al*, 1979). Although the fundamental cause is unknown, a variety of factors may contribute to the development and perpetuation of the symptoms (Crisp, 1967a; Garfinkel *et al*, 1977; Russell, 1977). These include a neurotic personality (Smart *et al*, 1976), specific fears over impending sexuality and a lack of other adolescent coping capacities (Crisp, 1980; Meyer, 1961), family conflicts (Minuchin *et al*, 1978), body image disturbances (Slade & Russell, 1973), and primary or secondary hypothalamic dysfunction (Russell, 1970). Bruch (1974) has described the anorexic patient as being trapped in a particular pattern of behaviour, which Crisp (1980) sees as a phobic avoidance of the featured mature body weight and of the maturational challenge it imposes on the individual and her family.

Dieting is widespread among adolescent women (Hueneman *et al*, 1966; Nylander, 1971; Crisp, 1983), but the relative contributions of specific life experiences and of constitutional factors in the development of the fully established anorexic syndrome remains uncertain. The evidence for any genetic component has so far been inconclusive, but certain factors have been reported as being over-represented in anorexic families. These include obesity (Crisp, 1967a), depressive illness (Winokur *et al*, 1980), alcoholism, a concern over weight and 'middle class attitudes' (Crisp, 1980). Theander (1970) has reported a 6.6% sibling risk of anorexia nervosa in his series of 94 female anorexic patients. In a study of 102 anorexic patients, Crisp *et al*, (1980) found that 7% of the siblings, 14% of the mothers, and 9% of the fathers had a history consistent with a diagnosis of anorexia nervosa, and a further 10% of the mothers were obese. In a study of 13 male anorexic patients, Crisp & Toms (1972) reported that anorexia nervosa was present in three siblings, and suggested that the siblings were taking turns in stabilising the family dynamics through their anorexic behaviour. A more recent study (Hudson *et al*, 1983), using DSM III (American Psychiatric Association, 1980) criteria, reported a 5.9% occurrence of eating disorders among the 70 first-degree relatives of 14 anorexic probands.

The reports on twins with anorexia nervosa have been reviewed by four groups of authors (Garfinkel & Garner, 1982; Askevold & Heiberg, 1979; Vandereycken & Pierloot, 1981; Nowlin, 1983); Garfinkel & Garner list 27 pairs from the literature and add nine pairs of their own. Many of these reports can be criticised because zygosity was not clearly established and diagnostic criteria were not stated. However depending on the strictness of the inclusion criteria, between 38% and 55% of the 27 MZ pairs were concordant for anorexia nervosa. Nine DZ pairs have been reported; the five in Garfinkel & Garner's (1982) series and the three reported separately (Nemeth, 1977; Beaumont *et al*, 1978; Dickens, 1970) were all discordant. One pair reported by Morgan & Russell (1975), also included in the present study, was concordant for anorexia nervosa.

The aims of this study were: firstly, to investigate concordance rates for anorexia nervosa and other eating disorders in a relatively unselected and larger series of anorexic twins than has hitherto been reported; and secondly, to study the twins who were discordant for the disorder.

Method

Ascertainment

The twin probands all had anorexia nervosa and were identified from three separate sources. Fourteen pairs (15 probands) and one of a set of male triplets were collected together over the period 1960 to 1982, having been referred to one of the authors (A.H.C.) at St George's Hospital. These comprise all known twins and the one set of triplets referred over that time. During this period, because of the high referral rate of anorexia, twins were preferentially accepted at St George's, and in 13 of the 15 cases, the fact that they were twins was mentioned in the referral letter. Eleven pairs (12 probands) were ascertained through the Maudsley Hospital Twin Register from a consecutive series of referrals between 1967 and 1982. All twins were ascertained at the time of their initial referral. A further nine pairs heard about this study, contacted the Institute of Psychiatry, and volunteered to take part. The mean ages of the three groups, at the time of inclusion in the study, and their zygosity are shown in Table I.

Zygosity

The zygosity of 10 of the 14 same-sex DZ pairs and 16 of the 18 MZ pairs was established by blood group analysis; in all but one of the remaining pairs, the physical resemblance questionnaire was used. One male pair did not wish to take an active part in the study and zygosity (MZ) was based on the parents' account, given in earlier hospital notes; they have not been included in the concordance rate analysis. Altogether, there were 30 female pairs (16 MZ and 14 DZ).

Diagnostic criteria

The diagnosis of anorexia nervosa was based on a combination of the criteria used by Crisp (1967b) and Russell (1970) (Table II). Twins were said to be concordant for anorexia nervosa if they had both had an episode which met these criteria and lasted for at least three months, but the episodes need not have coincided in time. The diagnosis was categorised as severe or mild according to length of illness (Table II).

Data collection

All twin probands were contacted by letter and asked if they and their twin would take part in the study. In 18 pairs, both twins and their parents agreed to be seen; three pairs did not wish to take an active part, but their medical notes were sufficiently comprehensive for a reliable assessment to be made. In the remaining 14 pairs, either both twins or one twin and one or both parents were seen. In two pairs, one twin in each pair had died of anorexia nervosa.

Each twin and the parents were interviewed separately, using a semi-structured interview schedule. This was designed: (i) to explore the presence or absence of an eating disorder or other psychiatric illness in either of the twins; (ii) to obtain information on their birth order and weight, adverse perinatal factors, childhood neurotic traits, weight in childhood, age at menarche, and educational achievement; and (iii) to assess the dominance and other personality characteristics of each twin. Adverse perinatal factors were defined as either being below 1.5 kg at birth, having a period of at least two weeks in an incubator, or an abnormal presentation and assisted delivery (Farr, 1975). Childhood neurotic traits were said to be present if there was a history of recurrent unexplained symptoms such as headache or abdominal pain, enuresis after the age of four years, or episodes of anxiety, any of which were sufficient to alter functioning in childhood.

The diagnosis of anorexia nervosa was made from the information obtained at interview and from case notes. At the time of assessment, the height and weight of the twins were measured, and they completed the Crown Crisp Experiential Index (Hsu & Crisp, 1980), Eating Attitudes Test (Garner and Garfinkel, 1979) (results to be reported in a future paper) and Physical Resemblance Questionnaire. The concordance rates for anorexia nervosa were calculated separately for the female, male/female, and male pairs because of the marked difference in the prevalence of the disorder between the two sexes. The results of the concordance rates and the information on the discordant twin pairs were analysed using Fisher's exact probability test.

TABLE I

Zygosity of the 34 twin pairs and one set of triplets and the mean age of each group (years), at the time of inclusion in the study

	MZ		Female DZ		F/M DZ		
	Number	Age	Number	Age	Number	Age	Total
St George's	5*	29	8	24	2	25	15
Maudsley	6**	27	4	24	1	22	11
Volunteers	7	25	2	25	–	–	9
Total	18	27	14	24	3	23	35

*Including one set of male triplets
**Including one set of male twins

TABLE II

Diagnostic criteria for anorexia nervosa

1) An intense fear of fatness and excessive pursuit of thinness
2) Self induced weight loss, usually by carbohydrate restriction, but this could include self induced vomiting, laxative abuse or excessive exercise
3) Amenorrhoea (for at least three months)

The anorexia nervosa was classified as severe if the weight remained below 75% of pre-illness body weight for at least one year, or there had been three or more admissions to hospital.

Results

Concordance for anorexia nervosa

Of the 30 female twin pairs, divided among the three groups, the following were concordant: two out of four MZ, and none of the eight DZ pairs in the St George's group; three out of five MZ and one out of four DZ pairs in the Maudsley group; and four out of seven MZ and neither of the two DZ pairs in the third group. Out of this total of 30 pairs, nine out of 16 MZ and one out of 14 DZ pairs were concordant for anorexia nervosa (see Table III) ($P = 0.0056$, Fisher's exact

TABLE III

Concordance for anorexia nervosa among the 30 female twin pairs

	MZ	DZ	Total
Concordant	9 (55%)	1 (7%)	10
Discordant	7	13	20
Total	16	14	30

P = 0.0056 (Fisher's exact probability test (one tailed))

probability test, one tailed). Given the known method of ascertainment of the Maudsley series, the concordance rate for probands in that group is 0.66 for MZ and 0.25 for DZ pairs. None of the three male/female DZ pairs, the male MZ pair, or the set of triplets were concordant. A brief history of the one concordant DZ pair is given in the Appendix.

Other eating disorders

One DZ co-twin in each of the hospital groups had episodes of abnormal eating behaviour resulting in weight loss. One (St George's group) was pre-occupied with weight and restricted her food intake, resulting in weight loss and irregular menstruation, but falling short of the diagnostic criteria for anorexia nervosa. The other lost weight during a severe depression and remained fussy over food, but did not express the characteristic morbid concern with body weight. There was no history of recurrent bulimia in any of the co-twins.

Other psychiatric illness

One non-anorexic MZ co-twin developed a severe obsessional handwashing disorder following her sister's recovery from anorexia nervosa, and two DZ co-twins had been treated for minor depression. Taking the 30 female twin pairs alone, ten out of 16 MZ and three out of 14 DZ pairs were concordant for psychiatric illness in general (including anorexia nervosa). The two non-anorexic male triplets, although not having a history of psychiatric illness, were socially isolated and leading reclusive lives. The non-anorexic male co-twin was diagnosed as having a conduct disorder in childhood. There was no history of psychiatric illness in the males of the three male/female pairs.

Family history

This was based on the parents' and twins' accounts. An individual who had psychiatric treatment was considered as having a positive psychiatric history. In 10 out of the 35 families, there was a history of psychiatric illness in one or other parent. In eight, one parent had been treated for depression; in the other two, a mother had suffered from anorexia nervosa, and a father had a leucotomy for a chronic affective disorder. With the MZ twin pairs, there was a trend towards an association between concordance for anorexia nervosa and a positive psychiatric history in the parents (see Table IV). In the case of the 14 same-sex DZ pairs, the one concordant pair and nine discordant pairs did not have a history of psychiatric illness in either parent. The four remaining pairs had a positive family history.

Concordance and severity of anorexia nervosa

In the ten (nine MZ and one DZ) concordant twin pairs, the probands all had severe anorexia nervosa. In six pairs, both twin and co-twin had severe anorexia nervosa and in four pairs only the proband was so affected. In the 24 discordant twin pairs and in the set of triplets, 14 (five MZ and nine DZ) probands had the severe form of the illness. Table V shows the relationship between severity and concordance in the MZ twin pairs and triplets.

Discordant MZ pairs

Eight out of the 17 (one male and 16 female) MZ twin pairs and the set of triplets were discordant for anorexia nervosa. The anorexic and their non anorexic co-twins were evenly divided as regards birth order, being the heavier at birth and educational success. In the seven pairs in whom there was a history of adverse perinatal factors, these had predominantly affected the anorexic twin in five, and both twins in two pairs. Similarly, childhood neurotic traits had been present in the anorexic twin alone in four out of eight pairs. In none of the pairs did the non-anorexic twin alone have such a history. In four out of the five pairs in which a difference was reported, the anorexic twin had been heavier in childhood. The anorexic twin was second to reach the menarche in four out of the six pairs and was less dominant in six out of eight pairs and in the set of triplets. The collection of these data is open to retrospective bias and the numbers too small for detailed statistical analysis, but they are presented here as an indication of possible trends that might explain discordance.

Discussion

The validity of any conclusions from a twin study depends on the method of ascertainment, zygosity

TABLE IV

Concordance for anorexia nervosa in the 17 MZ twin pairs (16 female, 1 male) and 1 set of triplets and the relationship to a history of psychiatric illness (PH) in the parents.

	PH +ve	PH −ve	Total
Concordant	5	4	9
Discordant	1	8	9
Total	6	12	18

P = 0.066 (Fisher's exact probability test (one tailed))

TABLE V

Concordance for anorexia nervosa in the 17 MZ twin pairs and one set of triplets and the relationship to the severity of the anorexia nervosa in the proband

	Severe	Not severe	Total
Concordant	9	0	9
Discordant	6	3	9
Total	15	3	18

P = 0.10 (Fisher's exact probability test (one tailed))

determination, and the use of clearly defined diagnostic criteria (Gottesman & Carey, 1983). In the St George's Hospital series, the special interest of the department in anorexia nervosa meant that there were more referrals than could be accepted, and twins were preferentially seen. During the period 1960 to 1982, the twin to singletons ratio was 1 to 40 and was clearly influenced by a variety of factors biasing the sample. The established Twin Register at the Maudsley hospital enables full ascertainment of all twins from a consecutive series of referrals, the twins being identified routinely at the time of their first appointment. The referral letters for the Maudsley series do not suggest that twins were sent there preferentially. The ratio of twin to singletons in this series was 1 to 50, similar to the ratio in the general population. Norris (1979) and Dally & Gomez (1979) have reported a similar 1 to 50 ratio in consecutive series of anorexic patients. It seems probable that twins are no more likely than singletons to develop anorexia nervosa, and that the Maudsley series is fully ascertained.

In this study, zygosity was established by blood-group analysis or by use of the physical resemblance questionnaire, in all but one pair. Both these methods are highly reliable (Giblett, 1969; Cohen *et al*, 1975). Recognised criteria, agreed between the authors, were used for diagnosis. Although the authors were aware of the likely zygosity at the time of assessment, the diagnosis had previously been established in the majority of cases, and strict application of the criteria minimised possible bias. A further criticism of twin studies is that the twins, at the time of inclusion in the study, may not have been old enough to have passed through the period of risk for developing the disorder. In this study, the mean age of each group at the time of the study was towards the end of the period of likelihood for developing the disorder. Thus, neither selection bias nor other methodological problems account for the observed concordance rate differences between MZ and DZ pairs.

Theander (1970) used the term 'induction' and Shafii *et al*, (1975) 'anorexia *a deux*' to describe the psychological process involved when anorexia nervosa occurred in more than one member of the family. In general, concordance in twins has been explained in these terms, rather than by a genetic predisposition to the disorder. In this study, no one psychological mechanism appeared to account for the concordance in the nine MZ and one DZ pairs; in some, the anorexia had run a parallel course and in others it developed at different times. In one pair, the twins developed anorexia nervosa while living in different countries, one concealing this from the other. The number of discordant MZ pairs was small. In one case a major life event (death of her husband) had initiated a period of depression and later classical anorexia nervosa; the co-twin was thin, but had never developed the disorder. As in the two pairs described by Bruch (1969), there was a tendency for the anorexic twin to have been disadvantaged since birth and to be the less dominant of the pair. Many of the factors described in families with anorexic children were observed (Minuchin *et al*, 1975), e.g., marital disharmony, the inability to exert independence from the family group (enmeshment), pressure to pass examinations, or an inability of the parents to help their children with the problems of adolescence. These particular stresses appeared important in individual cases, but the question remains as to why MZ, compared to DZ pairs, were more frequently concordant. When the MZ pairs were analysed separately, there was a trend towards concordance in the MZ twins being associated with a familiar loading for psychiatric illness, but not directly to the severity of the disorder, though it is of note that in none of the concordant pairs did the proband have the less severe from of the disorder. The small numbers make these results difficult to interpret, and these two aspects of family history and severity need further study. However, we suggest two broad explanations of our findings.

The first is that there is a genetic predisposition to anorexia nervosa, which could become manifest under adverse conditions such as inappropriate dieting or emotional stress. Such a genetic vulnerability might be a predisposition to a particular personality type, to psychiatric illness in general (and in particular affective disorder), to a disturbance of body image, or to a hypothalamic disorder. Thus, MZ twins carrying one or more vulnerability factors would both have the potential for developing anorexia nervosa under conditions of stress. Other factors such as earlier life experiences or particular life events may be different in each of the twins, thus influencing the expression of the disorder. DZ twins share an average of only half of their genes, and therefore would share any genetic vulnerability proportionally less frequently. Given the concordance rate for probands of the unselected Maudsley series and assuming a maximum prevalence of anorexia nervosa in young females of 1%, it is possible to calculate the relative influence of genetic and non-genetic familial effects (Gottesman & Carey, 1983). Smith (1974) published a graph in which an estimate of the correlation in liability between relatives can be obtained. The broad heritability for anorexia nervosa can be calculated by doubling the differences between the MZ and DZ correlations, giving an estimate of 0.54, and one of 0.38 for non-genetic familial effects. Such estimations from a small sample should be treated with caution, as they are liable to a large standard error. The components of heritability,

however, remain a matter of speculation, and we suggest that this cannot solely be explained by a vulnerability to affective disorder. Thirteen per cent of the parents in our study had suffered from an affective disorder, which is closer to the rate in the control families reported by Winokur *et al*, (1980) rather than to the rate found in the parents of their probands with anorexia nervosa. In two twin pairs, depression occurred in the co-twins without features of anorexia nervosa.

The second possible explanation is that the 'equal environment' assumption (Plomin *et al*, 1980), made in twin research, is incorrect for anorexia nervosa, and that the MZ, compared to the DZ pairs, are treated in a more similar way, and are, therefore, more susceptible to the process of induction. At the time of adolescence, twins are exposed to the particular challenge of separation, and the development of anorexia nervosa may then reduce the individuals to an identical state, eliminating actual differences which may have emerged. This may be viewed by the twins as a protection from separation, or as a chance for reunification if they are not living together. It has therefore been claimed that anorexia nervosa arises as an alternative to personality development and differentiation in adolescence (Crisp & Bhat, 1982). The task of differentiation may be uniquely complicated in MZ compared to DZ twins, and anorexia nervosa may arise conjointly in an attempt to prevent the difficult task facing these twins in adolescence. Studies of normal twins, however, suggest that the opposite might be true, and that some parents and twins may attempt to exaggerate any slight differences, so as to encourage individual development (Plomin *et al*, 1980), but this may not be the case in families where one twin develops anorexia nervosa. If this was the explanation of the differences in concordance rate, then one might expect MZ twins to develop the disorder more frequently than singletons: this appears not to be the case.

The explanation of the observed differences in concordance rate anorexia nervosa requires further study. Although the genetic vulnerability explanation is more plausible, the 'induction' theory cannot be ruled out, and elucidation of the interrelationship between a possible genetic predisposition and life experience needs to be explored further.

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Appendix

The W Twins were DZ by blood group analysis, and were concordant for anorexia nervosa. *History of anorexia nervosa:* twin 2 started dieting aged 14 after becoming concerned that she had prominent veins in her legs, which she felt were due to the fact that she weighed 10 stones. She lost 30 pounds and her periods stopped. Over two years she had three admissions to hospital, and treatment included weight gain, anti-depressant therapy, chlorpromazine and insulin therapy. Twin 1 tried to diet at the same time but was forced to eat by her sister. When aged 17 her weight went down to seven stones and her periods stopped for several months. She did not require treatment. *Personal History:* after a difficult pregnancy, the twins were born four weeks prematurely, and weighed nearly 6 pounds each at birth. There were no perinatal problems. Twin 1 was reported as slightly developmentally ahead of twin 2, and she was described as being more nervous and skinnier as a child. Twin 2 was a perfectionist, more successful at school (passing the 11+ which her sister failed) and the more adventurous. Both had boy friends in adolescence. Twin 1 reach menarche one year after twin 2. Both are now married with children. *Family history:* they had good relationships with their parents. Neither their parents or older sister have a history of psychiatric illness. A maternal aunt had a leucotomy for 'recurrent worries'. *Past medical illness;* twin 2 had two epileptic fits in childhood and was on phenobarbitone for one year. *Present situation:* twin 2 declined to be seen for the study but she is reported to be well by her mother. Twin 1 has not had a recurrence of anorexia nervosa and at present weighs 8 stone 10 pounds.

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