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Birth weight in opposite sex twins as compared to same sex dizygotic twins

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Summary

The question addressed in the present report is whether the large birth weight differences in dizygotic twin pairs of opposite sex (DZos), especially in 'male first' couples — observed by Blickstein and Weissman (Blickstein I, Weissman A. Birth weight discordancy in male-first and female-first pairs of unlike-sexed twins. Am J Obstet Gynecol 1990;162:661–663) and replicated in the present study — can be explained by two general influences on birth weight, viz. sex and birth order, or whether some specific effect on fetal growth has to be assumed that is present only in twin pairs of differing sex. The associated enhanced health risk would hit the female twin (from a male first-female second couple) in the first place. If the hypothesis is correct, then one may expect that birth weight of twins is somehow dependent on the sex of the co-twin. This was studied in 3069 twin pairs born in The Netherlands since the end of 1986. Results show that among DZ twins, birth weight is not affected by the sex of the co-twin. Therefore, birth weight differences in DZos pairs have to be ascribed to the general effects of sex and birth order. There is no effect that is specific to DZos pairs only.

Twins; Birth weight; Sex; Birth order

Introduction

Boys weigh more than girls at birth. This fact has been well documented [1–3] and is an indication that fetal sex affects intrauterine growth. This gender-determined birth-weight effect holds for both singletons and twins [4,5]. Furthermore, the average birth weight of first-born twins is higher than that of second-born twins [6].

The question can be raised whether the often observed, rather large discordance in birth weight in twin pairs of opposite sex — especially in male first pairs — can be explained by the combined effects of gender and birth order, or whether a specific factor, produced by the opposite sex combination, is involved. In a group of 153 twin pairs of unlike sex, Blickstein and Weissman [7] found that males were heavier than females. This difference was, however, only significant in pairs from which the boy was born first (male-female or mf). In this group of DZos twins the authors did not find a significant birth weight difference between first- and second-born boys, nor between first- and second-born girls. All these findings are congruent

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with their observation that in mf pairs the girl was, in 31% of all cases, more than 15% lighter than the boy (the opposite holding for only 2.8% of all cases), whereas in fm pairs these figures were 21.9% and 9.8% for boys and girls, respectively. The authors conclude that females of different-sex twin pairs have a significantly increased, birth-order independent, risk of being growth discordant (being more than 15% lighter than the co-twin; 15% is a clinical accepted criterion), but significantly more so in mf than in fm pairs. In other words, girls from mf pairs would have statistically more health risks, according to Blickstein and Weissman. The question yet unanswered is whether the intra-pair differences in birth weight as observed by Blickstein and Weissman can be explained by two general conditions affecting birth weight, viz., sex and birth order. To answer this question it is insufficient to restrict the research design to opposite sex twin pairs only, as Blickstein and Weissman did: it is necessary to test the dependency of the birth weight of twins on the sex of the co-twin. Such a test can only be done in a twin sample with both DZ same sex (DZss), both male and female and DZos twin pairs. This paper presents the results of that test.

Materials and Methods

About 40% of all twins born in The Netherlands since the end of 1986 are registrated in The Dutch Twin Register. Parents have given their written permission to list their family in the Register and their willingness to cooperate in future research. Once in a year a questionnaire is mailed to them, the first one shortly after birth, asking about several health and behavioral characteristics, zygosity, birth weight, etc. The total sample comprises 3275 twin pairs. For 176 pairs zygosity information was incomplete or not available and for another 30 pairs birth weight values were lacking. Thus, the necessary information about birth order, zygosity, birth weight and sex was complete for 3069 twin pairs. Zygosity was assessed (with a questionnaire) shortly after birth and once again when the twins were about 2 years of age. For 1540 pairs of twins the zygosity determination was based on the first questionnaire only (including also the opinion of the obstetrician, obtained via the mother) and for 1529 pairs on combined information from both the first and the second questionnaire. The use of a questionnaire for zygosity assessment leads to an estimated proportion of misclassifications (among like sex twin pairs) of about 4% [8].

The following abbreviations will be used: MZ and DZ for monozygotic and dizygotic, respectively, m and f for male and female, fm designating pairs from which the girl was born first (oldest) and mf designating pairs from which the boy was born first. The abbreviations ss and os mean same sex and opposite sex, respectively.

Results

Table I presents the mean birth weights for each zygosity type, for both the oldest and the youngest of a pair. When sex is the same, there is an average birth weight advantage for the oldest of a couple of 61 g in DZ pairs and a bit less in MZ pairs. The difference between DZss and MZ intra-pair weight differences is however not significant (independent t-test: $t = 0.62$; NS). MZ figures are presented for the sake of completeness. The rest of the data analysis is restricted to DZ twin pairs only. Within the category of DZ twins we have tested whether the different sub-categories (i.e. DZmm, DZff, DZmf and DZfm) differed with respect to gestational age. This appeared not to be the case [one-way ANOVA: $F(3,2290) = 1.28$ (NS); mean gestational age was 37.23 weeks (S.D. = 2.54)].

The larger intra-pair difference in DZmf pairs and the negative difference in DZfm pairs could be caused by the combined effects of sex and birth order in these zygosity categories, and — possibly — some additional effect on birth weight, produced by the sex of the co-twin. We will therefore consider whether the birth weight of a twin varies with the sex of its co-twin. The first question then is whether birth weight of the youngest of a pair depends on the sex of its first-born co-twin. Table II presents mean birth weights of the youngest boys and girls (columns) as a function of the sex of their older co-twin (rows). This table shows that mean birth weight of second-born twins (both boys and girls) is independent of the sex of the

TABLE I

Mean birth weight (g) per zygosity type and birth order

Zygosity[a]	No. of pairs	Weight oldest (S.D.)	Weight youngest (S.D.)	Difference O – Y	Paired *t*-test	*P*
MZmm	371	2453 (536)	2393 (534)	60	2.83	< 0.005
MZff	421	2389 (490)	2341 (523)	48	2.57	< 0.01
DZmm	651	2634 (518)	2567 (501)	67	3.94	< 0.00
DZff	594	2538 (544)	2483 (557)	55	3.21	< 0.001
DZmf	542	2666 (524)	2473 (521)	193	10.84	< 0.00
DZfm	490	2497 (529)	2574 (569)	–77	3.85	< 0.00

[a]MZ, monozygolic; DZ, dizygotic; f, female; m, male; mf, male born first; fm, female born first.

first-born co-twin (non-significant *t*-values in bottom lines of the table). Further, one can see that second-born boys weigh more than second-born girls and that the magnitude of that difference is independent of the sex of the first-born co-twin. The next question is whether mean birth weight of first-born twins (the oldest) depends on the sex of their second-born co-twin. Table III shows — in analogy of Table II — the results.

Table III makes clear that mean birth weight of first-born twins (both boys and girls) is independent of the sex of the second-born co-twin (non-significant *t*-values in bottom lines of Table III). Further, the surplus weight of first-born boys relative to first-born girls is the same in case of a male co-twin as in case of a female co-twin. Finally, the sex difference in birth weight among first-born twins is not statistically larger than that among second-born twins ($t = 1.10$). Both the difference between the oldest DZmm and DZff, on the one hand, and the youngest DZmm and DZff, on the other hand, are smaller than the comparable differences between DZmf and DZfm pairs (84 and 96 g versus 101 and 169 g). This difference in differences is, however, not significant ($t = 1.63$; $P < 0.10$).

Comment

The average birth weight of DZss (mm and ff taken together) and DZos is the same (2557 and 2554 g, respectively). Furthermore, there is — within the DZss category — an effect on birth weight of both sex (boys being on the average

TABLE II

Dizygotic twins: mean birth weight (g) of *youngest* (last born) twin as a function of own sex and sex of co-twin

Sex oldest	Weight youngest		Dif	*t*[a]	*P*
	Male	Female			
Male	2567 S.D. = 501 *N* = 651	2473 S.D. = 521 *N* = 542	94	3.15	< 0.001
Female	2574 S.D. = 569 *N* = 490	2483 S.D. = 557 *N* = 594	91	2.64	< 0.001
Dif	7	10	3		
t-test	0.31				
	NS	NS			

[a]*t*-test for independent samples.

TABLE III

Dizygotic twins: mean birth weight (g) of *oldest* (first born) twin as a function of own sex and sex of co-twin

Sex youngest	Weight oldest		Dif	t[a]	P
	Male	Female			
Male	2634 S.D. = 518 N = 651	2497 S.D. = 544 N = 490	137	4.37	< 0.001
Female	2666 S.D. = 524 N = 542	2538 S.D. = 544 N = 594	128	4.03	< 0.001
Dif	32	41	9		
t-test[a]	1.05	1.25			
P	NS	NS			

[a] t-test for independent samples.

89 g heavier than girls) and birth order (first-borns weighing about 61 g more than second-borns). This could mean that the relatively large differences in birth weight between members of twin pairs of opposite sex — observed by Blickstein and Weissman [7] and confirmed in the present study — can be ascribed to the combined effects on birth weight of sex and birth order. If this is true, then it is necessary that mean birth weight of twins is not influenced by the sex of the co-twin. This appears to be the case: both first- and second-born boys and girls have birth weights that are independent of the sex of their co-twin. The general conclusion of Blickstein and Weissman [7], 'that the female sex is an important cause . . . for intertwin birth weight disparity' and ' . . . the female twin is more likely to be affected . . . in the female-second combination', is very likely to be incorrect. There are a number of reasons for this: first, the female sex seems not to affect birth weight of male co-twins, both in DZmf and DZfm pairs; second, male sex in pairs of unlike sex leaves birth weight of female partners unchanged. When first-born male twins are compared with first-born female twins and when second-born male twins are compared with second-born female twins, then there is a non-significant trend that this sex effect is smaller in comparisons between same sex pairs than between opposite sex pairs.

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