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Lower Marriage and Divorce Rates Among Twins Than Among Singletons in Danish Birth Cohorts 1940–1964

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Few studies have examined differences of civil status of twins and singletons and the conclusions are contradictory. In the present study, based on a linkage between the Danish Twin Register, a random 5% sample of the total Danish population, and administrative register databases, the authors compare rates of marriage and divorce in a sample of 35,975 twins and 81,803 singletons born 1940–1964. Cox-regressions are used in order to control for potential confounders. We find that compared with singletons twins have significantly lower marriage rates: (males: 15–19 years: Hazard Ratio (HR) = 0.66 (95%CI: 0.58–0.76); 20–24 years: 0.85 (0.82–0.88); 25 years or more: 0.96 (0.93–0.98) and females: 15–19 years: 0.70 (0.67–0.75); 20–24 years: 0.83 (0.80–0.85); 25 years or more: 0.94 (0.91–0.97)). There is no difference in divorce rates for males, but a significantly lower divorce rate for female twins compared with singletons (HR=0.87, 95%CI: 0.83–0.90). These differences offset each other, thus 57% of both populations remain in their first marriage until censoring. The interpretation may be that since twins have a partner from birth, they do not have the same need for marriage as singletons but have more experience in maintaining a relationship if they do marry.

■ **Keywords:** twins, singletons, marriage rate, divorce rate, Denmark, register study

In 1976 Zazzo compared the propensity to marry in a group of French twins and singletons. The study was based on official registries of marriage in the municipality of Paris. He found that the proportion of married twins among 283 pairs from birth cohorts 1883–1902 was substantially lower than the proportion among 500 singletons. He did not include any statistical tests to support his claims but, nonetheless, stated that (Zazzo, 1976):

> … the figures seem to confirm the hypothesis that I held when observing so often in adult twins their hostility or at least their indifference to marriage, and despair of some of them when their partner decided to get married.

Initial findings from the Finnish Twin Registry demonstrated that at all ages fewer twins than singletons were married in 1976 and that the differences were more pronounced for females than males (Kaprio et al., 1979). In a small study conducted by Pearlman of 60 twins and 30 singletons from US, the author did not find any evidence of a lower frequency of marriage among twins compared with singletons (Pearlman, 1990). Neither did the author find any statistically significant differences between twins and singletons with respect to number of years being married, whether having previously been married, number of previous marriages, or number of years since divorce. Johnson et al. analyzed social closeness in a sample of twins, their spouses, siblings, offspring, and parents recruited from the Minnesota Twin Register (7,169 twins and 5,802 relatives). They found higher social

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closeness in twins compared with singletons, but the authors stated that this might not necessarily be an obstacle when it comes to the quality of the twins' social bonds to others (Johnson et al., 2002):

> It is interesting to speculate, nonetheless, whether the twins' greater Social Closeness extends to others around them or is primarily limited to the twin pair bond.

The effect of social closeness within twin pairs on their relationships to other peers was investigated in a study of 107 Canadian twin pairs where the authors concluded that (Foy et al., 2001):

> … this study does not support the conclusion that having an intimate twin relationship interferes with the formation of close relationships with others during late adolescence or throughout adulthood.

Middeldorp et al. examined the frequency of divorce and break-up of a relationship in a large sample of adolescent and young adult Dutch twins and their singleton siblings (Middeldorp et al., 2005). The authors found that in one female group (mean age: 27) monozygotic twins were less likely to be involved in a romantic relationship, dizygotic twins were intermediate, and singletons were most likely to be involved in a relationship. Otherwise no significant differences between the groups were demonstrated. Contrary to this finding Lykken et al. used a large sample of twins from the Minnesota Twin Register to compare the marriage and divorce rates of 4,855 twins from birth cohorts 1936–55 at age 34–54 (Lykken et al., 1990). They did not find any significant differences between monozygotic and dizygotic twins.

Risk factors of divorce were examined in a study of 54,178 Norwegian first marriages. This study demonstrated that couples with an age-difference of more than 4 years, couples married at younger ages (less than 25 years), without children, and low educational level had a higher divorce risk (Lyngstad, 2004).

In the present register study we compare marriage and divorce rates of 35,975 twins with that of 91,803 singletons from Danish birth cohorts 1940–1964 controlling for several potential confounders: birth cohort, age at marriage, age difference within couples, presence of children within marriage, and educational level.

Material and Methods

Data

The data material was obtained through a linkage of the Danish Twin Register with administrative databases held at Statistics Denmark. The Danish Twin Register comprises more than 75,000 twin pairs born in Denmark since 1870 (Skytthe et al., 2006). Zygosity of same-sex pairs has been classified by means of a mail-back questionnaire consisting of four standard questions on physical similarity, a method with less than 5% misclassification (Christiansen et al., 2003). Furthermore, the study included a 5% random sample of the total Danish population from each birth year from 1870–2002 either alive at the start of the Danish Civil Person Register (CPR) April 2, 1968 or born thereafter. Linkage between registries is feasible due to a unique 10-digit personal identification number given to all residents of Denmark alive at the establishment of the CPR-register, at immigration, or birth if born after this date (Pedersen et al., 2006). Birth cohorts earlier than 1940 were excluded in order to minimize the risk of not observing first marriage while birth cohorts later than 1964 were excluded due to short follow-up time and therefore a low prevalence of divorce. Date of marriage among immigrants is not registered in Danish records unless the marriage took place in Denmark; therefore we restricted the sample to individuals born in Denmark.

Confounders

The CPR-register holds event-based information on marital status (single, married, divorced or widowed), and linkage to spouses as well as children. At the start of the CPR-register information on the present marital status, including date of the last registered change in marital status, was retrieved from local registries in April 1968. Age at first marriage as well as the age difference within the married couple for the sample was calculated from these data. Furthermore, we obtained information on whether the married couple had any children in common. The linkage between parents and children is not complete for children born in the period from 1960–1968 (approximately 95% of all children have a link to their father whereas approximately 99% have a link to their mother) but approximately 100% for all children born after April 2, 1968 have a link. Hence, we expect that more than 95% of the children of our study sample are identified.

From the Integrated Database for Labor Market Research (IDA; Emerek et al., 1990) we have information on the highest educational qualification obtained. The IDA database begins in 1980, we therefore used the registered education from 1980 for birth cohorts 1940–49 and for the subsequent birth cohorts we used the educational code for the year of their 30th birthday. From the International Standard Classification of Education code (ISCED) (Unesco, 2006) we created a three level educational code (< 10 years (pre-primary, primary and secondary), 10–12 years (upper secondary, post-secondary non-tertiary education), and 13+ years (tertiary)) for the sample along with their spouses and assigned an ISCED code for the couple consisting of the maximum educational level within the pair. We added a fourth category consisting of those with unknown educational level (educational level was unknown for 1,803 twins (5.1%) and 4,966 singletons (5.6%)).

The sample comprised 35,975 twins and 91,803 singletons from birth cohorts 1940–64 of which 28,495 (79.2%) twins and 75,276 (82.0%) singletons were ever married.

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We had information on date of marriage on 27,675 twins (97%) and 89,253 singletons (97%), information was missing either because they were divorced/widowed prior to April 2 1968 or due to errors in the registration.

Statistical Methods

The frequency of marriage, mean and standard deviation of age at first marriage as well as the frequency of divorces among married individuals was calculated separately for each sex and twin/singleton status as well as by zygosity.

Kaplan-Meier plots for marriage and divorce separately were generated and Cox regression was used to estimate the hazard rates (HR) comparing divorce and marriage rates of twins and singletons. Entry of study was age 15 for marriage rates and date of marriage for divorce rates, while exit of study was event (first marriage and divorce, respectively) or censoring due to death, widowhood or end of study (January 1, 2003) whatever came first. Regressions were performed separately for each sex and controlled for potential confounders. Estimation of HR for marriage was controlled for educational level (in 1980 or at age 30 for birth cohorts 1950–64) and 5-year birth cohort; while for divorce rates we controlled for quintiles of age at first marriage, age difference within the married couple (four groups: 0–4 years, 4–9 years, 10–19 years, and 20+ years), birth cohort (5-year intervals), educational level (couples ISCED code), and whether the couple had any children in common. Educational level, birth cohort and quintiles of age at marriage and difference of age within couple were modeled using dummy variables. To avoid violations of the proportional hazard assumption we modeled time-varying covariate effects by splitting the data at specified time points. We used Aalens additive models (Hosmer & Royston, 2002) to choose the time points for which the effects of covariates were allowed to change. Thus, covariate effects were allowed to change at time points 5 and 10 years for the Cox analyses of marriage rates while for divorce rates we allowed changes at 1 year and 10 years. We clustered the observations on twin pairs (using Stata's cluster option on twin pair id) to take account for potential correlation within pairs. Individuals with missing information on date of marriage were excluded from the regression analyses.

We repeated the analyses including a dummy variable for zygosity in order to investigate the effect of self-reported zygosity. Unknown zygosity twins were further divided into 2 subgroups: twins whose zygosity was unresolved due to contradicting responses to the questionnaire and a second group where zygosity was unknown due to non-response. Furthermore we have performed analyses comparing same-sex twins with opposite-sex twins.

Stata 10.1 was used for all analyses.

Results

Table 1 gives the overall frequencies of ever marriage as well as divorce from first marriage, along with summary of age at first marriage and age of survivors on January 1, 2003 stratified by twin/singleton status and sex. The results show that age at first marriage for both males and females is higher for twins compared with singletons (overall age difference is 0.8 years ($p < .001$) for males and 1.3 years ($p < .001$) for females) and fewer twins marry compared with singletons; the overall marriage frequency for males was 78.1% for singletons and 76.0% for twins, the numbers for females were 86.1% respectively 82.9%. The results for divorce show that fewer twins than singletons are divorced (29.6% vs. 30.4% ($p = .09$) for males and 27.3% vs. 31.3% ($p < .001$) for females).

The Kaplan-Meier plots for marriage are pictured in Figure 1. The plots demonstrate a higher marriage rate among singletons compared with twins for males as well as females. The differences occur at the beginning of the observation period and persist at a virtually constant level throughout the observation period. Figure 2 depicts the Kaplan-Meier plots for divorce. These plots demonstrate

TABLE 1

Mean Age at First Marriage and Overall Frequencies of Ever Marriage and Divorce on January 1, 2003 Among 35,975 Twins and 91,803 Singletons from Danish Birth Cohorts 1940–1964

	Males		Females	
	Twins	Singletons	Twins	Singletons
Total number	19,291	47,067	16,684	44,736
Alive on January 1, 2003, *n* (%) [a]	18,366 (95.2)	44,850 (95.3)	16,258 (97.4)	43,663 (97.6)
Age on January 1, 2003, mean (*SD*) [b]	50.7 (7.2)	50.4 (7.1)	50.3 (7.4)	50.5 (7.2)
Married, *n* (%) [a]	14,662 (76.0)	36,742 (78.1)	13,833 (82.9)	38,534 (86.1)
Divorced, *n* (%) [c]	4,346 (29.6)	11,168 (30.4)	3,780 (27.3)	12,076 (31.3)
Divorced or widowed before April 2 1968, n (%) [a]	132 (0.7)	380 (0.8)	173 (1.0)	567 (1.3)
Error in registration, *n* (%) [a]	251 (1.3)	689 (1.5)	264 (1.6)	914 (2.0)
Study base, *n* (%) [a]	18,908 (98.0)	45,998 (97.7)	16,247 (97.4)	43,255 (96.7)
Age at 1st marriage, mean (*SD*) [d]	31.9 (10.3)	31.1 (10.0)	28.6 (10.0)	27.3 (9.5)

Note: *SD*, standard deviation; [a] Percentage of total number; [b] Mean age of individuals alive on January 1, 2003; [c] Percentage of married individuals; [d] Age at first marriage of study base

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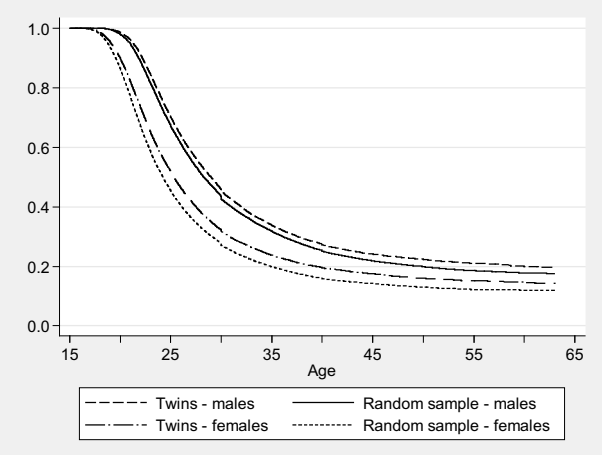

FIGURE 1

Kaplan-Meier plots for first marriage. Danish twins (n = 53,155) and a 5% random sample (n = 89,253) of each birth cohort from 1940–1964.

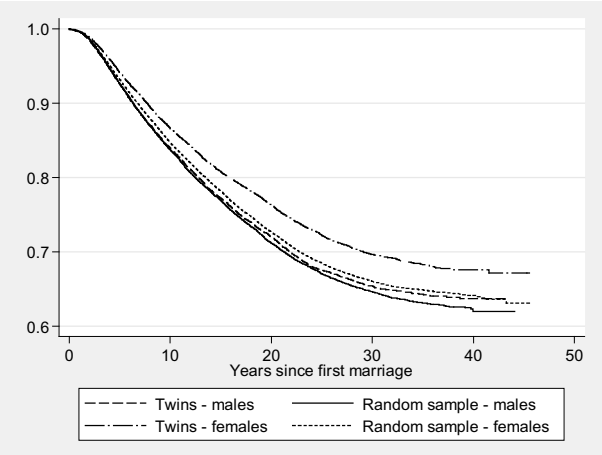

FIGURE 2

Kaplan-Meier plots for divorce from first marriage. Danish twins (n = 27,675) and a 5% random sample (n = 72,725) of each birth cohort from 1940–1964.

that female twins have a lower divorce rate, and the difference is increasing over time, compared with male twins, and male as well as female singletons but only small differences between these three latter groups.

The frequencies of marriage and divorce according to zygosity groups are reported in Table 2. The general picture is that twins with unknown zygosity (UZ) have lower frequency of marriage and higher frequency of divorce compared with the twins of known zygosity; the group of non-responders has the lowest marriage and the highest divorce rates of all groups. The three groups of known zygosity exhibit small differences with respect to frequency of marriage and divorce. The trend for both sexes is that the monozygotic (MZ) twins have the highest frequency of marriage and the lowest frequency of divorce, while opposite-sex (osDZ) twins have the lowest frequency of marriage (only males) and the highest frequency of divorce.

Comparison — without taking censoring into consideration — of the age at first marriage and frequencies of marriage and divorce of same-sex with opposite-sex twins proved quite small, and statistically insignificant, differences for males (ever married: 76.0% of same-sex and 76.1% of opposite-sex twins (p = .86); mean age at first marriage: 27.4 years for same-sex and 27.5 years for opposite-sex twins (p = .85); divorce: 29.4% for same-sex and 30.1% for opposite-sex twins (p = .37)). For females we observed a significantly (p = .04) higher frequency of marriage among opposite-sex twins (83.6%) compared with same-sex twins (82.4%), opposite-sex twins married on average slightly younger than same-sex twins (24.7 years and 25.1 years ($p < .001$)), and same-sex twins had a lower frequency of divorces than opposite-sex twins (26.4% vs. 28.7% ($p < .01$)).

Regressions

Raw and adjusted hazard ratios (HR) for marriage obtained through Cox regression using time-varying covariate effects (15–19 years, 20–24 years, and more than 25 years) are reported for males and females (Table 3). The

TABLE 2

Marital Status on January 31, 2003 (or at Death) of 35,975 Twins from Danish Birth Cohorts 1940–64

	Marriage				Divorce			
	Males		Females		Males		Females	
	Number [a]	Percent	Number [a]	Percent	Number [b]	Percent [c]	Number [b]	Percent [c]
Opposite-sex	6,905	76.1	6,690	83.6	5,253	30.1	5,595	28.7
All same-sex	12,386	76.0	9,994	82.4	9,409	29.4	8,238	26.4
Monozygotic	3,650	78.7	3,248	83.7	2,873	28.6	2,719	23.9
Same-sex dizygotic	7,185	76.8	5,791	82.7	5,520	28.7	4,788	26.2
Unknown zygosity	1,551	65.5	955	76.5	1,016	35.3	731	36.5
Unresolved [d]	498	69.1	349	78.2	344	32.6	273	27.8
Non-response [e]	1053	63.8	606	75.6	672	36.8	458	41.7

Note: [a] Total Sample; [b] Number of married individuals of the total sample; [c] Percent of married; [d] Twins with missing zygosity information due to conflicting answers on zygosity questionnaire; [e] Twins with missing zygosity information due to non-response on zygosity questionnaire

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TABLE 3

Overall Raw as well as Confounder Adjusted Hazard Ratios and 95% Confidence Intervals in Three Age Periods: 15–19 Years, 20–24 Years, 25+Years for 1st Marriage Among 35,155 Twins and 89,253 Singletons from Danish Birth Cohorts 1940–64 Using Singletons as Reference Group — Censoring at Death or End of Study (January 1, 2003)

	Raw		15–19 years		20–24 years		25+ years	
	HR	95%CI	HR [a]	95%CI	HR [a]	95%CI	HR [a]	95%CI
Males								
Twins (pooled)	0.93 ***	0.91–0.95	0.66 ***	0.58–0.76	0.85 ***	0.82–0.88	0.96 **	0.93–0.98
Monozygotic	0.97	0.93–1.01	0.66 **	0.48–0.89	0.87 ***	0.80–0.93	1.06 *	1.00–1.12
Same-sex dizygotic	0.95 **	0.92–0.98	0.66 ***	0.53–0.82	0.90 ***	0.86–0.94	0.96 *	0.92–1.00
Opposite-sex dizygotic	0.93 ***	0.90–0.95	0.63 ***	0.51–0.78	0.82 ***	0.78–0.86	0.97	0.93–1.00
Unknown zygosity	0.73 ***	0.68–0.79	0.82	0.55–1.20	0.77 ***	0.69–0.86	0.68 ***	0.62–0.75
Unresolved [b]	0.72 ***	0.64–0.81	0.47	0.17–1.24	0.63 ***	0.50–0.79	0.78 ***	0.68–0.89
Non-response [c]	0.74 ***	0.67–0.81	0.93	0.61–1.42	0.83 **	0.74–0.93	0.62 ***	0.55–0.71
Females								
Twins (pooled)	0.87 ***	0.85–0.88	0.70 ***	0.67–0.75	0.83 ***	0.80–0.85	0.94 ***	0.91–0.97
Monozygotic	0.86 ***	0.82–0.90	0.68 ***	0.59–0.78	0.82 ***	0.77–0.88	1.01	0.95–1.08
Same-sex dizygotic	0.86 ***	0.83–0.88	0.72 ***	0.66–0.79	0.82 ***	0.78–0.86	0.93 **	0.88–0.97
Opposite-sex dizygotic	0.90 ***	0.87–0.92	0.69 ***	0.64–0.75	0.87 ***	0.83–0.90	0.96	0.91–1.00
Unknown zygosity	0.76 ***	0.69–0.83	0.79 *	0.65–0.97	0.66 ***	0.58–0.74	0.68 ***	0.60–0.79
Unresolved [b]	0.77 ***	0.67–0.88	0.82	0.59–1.15	0.72 **	0.58–0.88	0.82	0.66–1.02
Non-response [c]	0.75 ***	0.67–0.85	0.78 *	0.61–0.99	0.63 ***	0.54–0.73	0.60 ***	0.50–0.71

Note: CI, Confidence Intervals; HR, Hazard Ratio; * $p < .05$; ** $p < .01$; *** $p < .001$

[a] Hazard ratios for marriage are adjusted for education and 5-year birth cohort.

[b] Twins with missing zygosity information due to conflicting answers on zygosity questionnaire

[c] Twins with missing zygosity information due to non-response on zygosity questionnaire

tables include results for the pooled twin sample as well as for the four zygosity groups (MZ, ssDZ, osDZ, and UZ) as well as for a further subdivision of UZ twins (conflicting answers and non-response). Except for MZ males and females, who on average stayed unmarried until 25 years of age, we found lower marriage rate for twins compared with singletons — most of them highly statistically significant. The results reveal that the HR's converges to 1 with increasing observation time for all groups of twins except for the twins of unknown zygosity where the largest HR is observed in the first time period (corresponding to 15–19 years of age); this opposite trend is mainly due to twins with unknown zygosity due to non-response. These results partly reflect that fewer twins marry compared with singletons and partly that twins marry at older ages (especially twins of known zygosity) compared with singletons.

The results of linear Aalen regression showed that there was no interaction between divorce and observation time for either sex. Thus we did not model time-varying effects of the outcome (divorce) in these analyses (but time-varying effects of the confounding covariates were included in the models). The results of the regressions are shown in Table 4. Statistically significant results for divorce rates are obtained for females (HR: 0.91 (95%CI: 0.87–0.94)) but not for males (HR: 0.99 (95%CI: 0.96–1.03)). Table 4 also reports the HR's of zygosity with singletons as reference group; the unknown zygosity demonstrates the highest divorce rates. While for females the higher divorce rates among twins of unknown zygosity was solely due to non-responders, we observed high divorce rates for both groups of male twins of unknown zygosity.

Discussion

In the present register-based study we found a lower, time-dependent (HR's are converging to one with increasing observation time) marriage rate among twins than among singletons and those twins that do marry are on average older at first marriage compared with singletons. We found non-significant hazard rates (HR) for divorce among males but we observed that female twins have significantly lower divorce rates compared with their singleton counterparts.

Comparison With Other Studies

In accordance with the French study (Zazzo, 1976) comparing the propensity of twins and singletons in Paris to marry, we demonstrated a lower percentage of ever-married twins compared with singletons, both for males (76% vs. 78%) and for females (83% vs. 86%). In contrast, Zazzo found a larger difference, 65% vs. 78% among 272 traceable twins and singletons. Zazzo's study concerns earlier birth cohorts (1882–1902) than the present study (1940–1964); his results are based on a small selected sample (566 twins of which 90 were traceable, and 500 randomly selected singletons of which 182 were traceable), and he did not take account of sex and age in his analyses, nor did he report any statistical tests. Furthermore, our study is supported by a cross-sectional study of Finnish twins by Kaprio et al. that found fewer twins of all ages

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TABLE 4

Raw as well as Confounder Adjusted Hazard Ratios and 95% Confidence Intervals for Divorce (From 1st Marriage) of 27,675 Twins (14,279 Males and 13,396 Females) and 72,725 Singletons (35,673 Males and 37,052 Females) from Danish Birth Cohorts 1940–64 using Singletons as Reference Group — Censoring at Death, Widowhood, or End of Study (January 1, 2003)

	Males				Females			
	Raw		Adjusted [a]		Raw		Adjusted [a]	
	HR	95%CI	HR	95%CI	HR	95%CI	HR	95%CI
Twins (pooled)	0.97	0.94–1.01	0.99	0.96–1.03	0.87 ***	0.83–0.90	0.91 ***	0.87–0.94
Monozygotic twins	0.99	0.91–1.07	1.00	0.92–1.08	0.79 ***	0.73–0.87	0.81 ***	0.74–0.89
Same-sex dizygotic twins	0.93 *	0.88–0.98	0.94 *	0.89–1.00	0.84 ***	0.79–0.89	0.88 ***	0.82–0.94
Opposite-sex twins	0.98	0.93–1.04	1.01	0.95–1.07	0.89 ***	0.84–0.94	0.94 *	0.89–0.99
Unknown zygosity	1.18 **	1.06–1.32	1.18 **	1.05–1.32	1.14	0.99–1.32	1.20 *	1.04–1.38
Unresolved [b]	1.17	0.95–1.45	1.20	0.97–1.47	0.92	0.72–1.19	0.94	0.72–1.22
Non-response [c]	1.19 *	1.04–1.36	1.17 *	1.03–1.34	1.27 **	1.08–1.51	1.36 ***	1.15–1.61

Note: CI, Confidence Interval; HR, Hazard Ratio; * $p < .05$; ** $p < .01$; *** $p < .001$

[a] Hazard Ratios are adjusted for couple education, 5-year birth cohort, quintiles of age at marriage, age difference within couple (0–4 years, 5–9 years, 10–19 years, and 20+ years), and whether the couple had any children in common.

[b] Twins with missing zygosity information due to conflicting answers on zygosity questionnaire

[c] Twins with missing zygosity information due to non-response on zygosity questionnaire

were married in 1976 compared with census data from 1970, and that the differences were smaller for males than females (Kaprio et al., 1979). The results in the present study contradicts the findings by Pearlman (1990) and Middeldorp et al. (2005), both reporting insignificant association between single-status and twin-singleton status. The conclusion drawn by Pearlman is based on a small sample of 60 twins and 30 singletons, and thus study size might explain why the author did not find significant results. Though statistically insignificant, the results of a Dutch study by Middeldorp et al. (2005) reports the same trend as found in the present study. Furthermore the authors of that study find — although still statistically insignificant — that the proportion of MZ twins having a spouse is lower than that of DZ twins. In the present study we find the opposite trend (Table 2). In the study performed by Zazzo (1976) a higher marital frequency was found among male same-sex twins (25%) compared with opposite-sex twins (15%), but no difference for females. Our study does not support this finding. For males we found that 76% of both same-sex and opposite-sex twins were ever married, while for females we found the opposite trend, that is, 82% of same-sex twins were married vs. 84% of opposite-sex twins. Contrary to the studies by Pearlman (1990) and Middeldorp et al. (2005) the data in our study demonstrate a lower frequency of divorces among twins compared with singletons. The lack of significance in previous studies might be due to small sample sizes and follow-up intervals that were too short. We have not been able to detect any previous studies comparing the age at first marriage of twins with that of singletons.

Previous studies have demonstrated that twins often are more closely attached to each other than non-twin siblings (Foy et al., 2001; Johnson et al., 2002). Zazzo (1976) observed this closeness within twin pairs and felt convinced that the tight bonds were causing the low marriage frequency among 283 twin pairs compared with the one in 500 singletons born in the municipality of Paris 1883–1902. The present study is based on register data. Hence, the interpretation of the results is based on pure conjecture. A possible interpretation is that the close bonds within twin pairs reduce their desire of bonding to a partner — thus reducing the marriage rate of twins. The time-dependent nature of the marriage rates reveals that the difference is mainly due to a lower teenage marriage rate. Hence, the twin-bonding may be loosened in adulthood, thereby giving room for evolving romantic relationships. This interpretation is furthermore justified by the slightly higher average age at marriage among twins compared with singletons. The interpretation of the lower divorce rates of female twins compared with singletons may be that twins are used to show consideration for their co-twin from the very beginning thereby training their adaptability of bond making.

Mortality

Several studies have established an association between mortality and marital status (Ben-Shlomo et al., 1993; Ebrahim et al., 1995; Hu & Goldman, 1990; Kotler & Wingard, 1989; Rosengren et al., 1989; Shaikh, 1990) probably both due to selection into marriage, that is, those with poor health and/or low socio-economic status stay single as well as health promoting effect of marriage. Previous studies comparing mortality of twins with that of the total Danish population did not demonstrate any differences (Christensen et al., 1995; 2001). Thus, it seems that single status is not as hazardous for twins as for singletons. This may be because the lower marriage rate of twins is counterbalanced by their lower divorce rate. Consequently, 53.5% of male twins and 54.3% male singletons remain in their first marriage until the end of the study, death or widowhood. The same numbers for

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females are 60.3% and 59.1%, respectively. Hence it is unlikely that lower marriage rate among twins is caused by poorer health of twins compared with that of singletons.

Unknown Zygosity

The unknown zygosity twins are a heterogeneous group consisting of identified twins who either didn't respond to the questionnaire on physical similarities or whose answers were inconsistent. In a previous register-based study of school achievements of Danish adolescent twins from birth cohorts 1986–1989 it was demonstrated that the parents of unknown zygosity twins had lower educational level and were slightly younger, and the UZ twins had significantly worse school achievements compared with twins of known zygosity (Petersen et al., 2009). In the present study we demonstrated that the unknown zygosity twins had lower marriage rates and higher divorce rates compared with twins of known zygosity, and the disadvantage was highest among non-responders. Hence, most likely it is the general picture that the twins whose zygosity is not accessible — especially those who didn't respond to the questionnaire — are disadvantaged compared to twins with known zygosity.

Limitations

Our study only covers legal marriages and not couples living together without being married. However, since 86% of all individuals from birth cohorts 1940–64 were or had been legally married in 2002 and furthermore we have no reason to believe that twins who live together are more likely to be unmarried than singletons living together, it is unlikely to introduce a bias to our study.

A second concern is the erroneous registration of date of marriage. Approximately 2.5% of our sample was excluded from the Cox analyses, either because they had ended their first marriage before the start of the CPR-register or due to registration errors. We found an uneven distribution of these exclusions in that more females than males were excluded and more singletons than twins were excluded. Still, the twin-singleton difference in exclusion rate is very small for both males (twins: 2.0%; singletons: 2.3%) and for females (twins: 2.6%; singletons: 3.3%), thus we do not expect that this causes any substantial bias in the results.

The Danish Twin Register holds approximately 70% of the twins born in the period from 1940–64, the remaining twins are mainly lost due to infant death of one or both of the twins prior to the start of the CPR register in April 1968 (Skytthe et al., 2002). Since we only include individuals surviving to age 15 the loss due to incompleteness is quite a lot lower: mainly twins surviving to age 15 without a surviving co-twin are missing in our sample. This might introduce a bias in our study if infant death is associated with marital status of the surviving twin.

Due to either non-response or conflicts of the answers, zygosity was missing for 11.2% of same-sex twins. This group has, as demonstrated in the present study, lower marriage as well as higher divorce rates compared with same-sex twins of known zygosity. Hence, the present results for MZ and same-sex DZ twins are slightly overestimated.

We have limited the study to first marriage. There may have been a few individuals who were married at a young age, and divorced and remarried before April 2, 1968. Since the oldest in our study are turning 28 in 1968 this group must be small and therefore we do not expect this to distort the results of our study.

Strengths

The size of the study (35,975 twins and 91,803 singletons) combined with the register-based results are the major strengths of the study. No prior study has examined such a large sample with minimal selection bias and loss to follow up.

Conclusion

We conclude that twins are married at slightly older ages compared with singletons, that twins have lower marriage rates compared with singletons, and that female twins have lower divorce rates compared with singletons, but no difference is observed for divorce rates among males. The results might indicate that twins do not have the same need for marriage as singletons but female twins are better at maintaining the marriage thereby avoiding divorce.

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