Survival Analysis

Survival from adult leukaemia in England and Wales up to 2001

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The leukaemias are a biologically and clinically diverse group of malignancies originating from precursors of the various blood cell series. Advances in basic science and cell surface markers in the last 20 years have led to revised clinical classifications of the leukaemias, as with the lymphomas (Percy et al., 1984), but these advances were not all reflected in the first two editions of the International Classification of Diseases for Oncology (ICD-O) (Percy et al., 1990; World Health Organisation, 1976), used by cancer registries world-wide to encode the morphology of neoplasms for robust international comparisons. The third edition of ICD-O incorporates these changes, but was introduced too recently to affect these data (Fritz et al., 2000). As a result, population-based data series from cancer registries cannot always be used to address clinical questions about trends in outcome for recently defined disease subgroups, as systematic realignment of older data to the more specific recent categories may be impossible. Acute and chronic myeloid leukaemia, chronic lymphoid leukaemia (CLL) and monocytic leukaemia account for 90% of leukaemias in adults in England and Wales. Acute lymphocytic leukaemia is mainly a disease of childhood. Information on survival for all adult leukaemias combined remains of some interest; however, even though the results are a weighted average of socioeconomic patterns and trends in survival for the different types of leukaemia.

Approximately 6200 adults are diagnosed with a leukaemia each year in England and Wales, some 3% of all malignancies. Incidence is marginally higher among more affluent groups, and approximately 30% higher in men overall, but the male excess is more marked for CLL. Incidence has been increasing only slowly since the 1970s, mostly among the elderly (Quinn et al., 2001). Geographic variation in incidence has not been marked.

Benzene and ionising radiation are well-established causes of leukaemia, although organic solvents, some viruses (IARC, 1996; Lynge et al., 1997; Stellman, 1998) and some antineoplastic drugs are also leukaemogenic (Kaldor et al., 1990). Nevertheless, all these potential causes explain only a small proportion of incident cases.

Of nearly 73 000 patients registered with a leukaemia in England and Wales during the period 1986–1999, only approximately 57 000 (78.3%) could be included in survival analyses. As many as 16% of patients were excluded from analysis because their dates of diagnosis and death were identical: this proportion was exceeded only for tumours of the lung and pancreas (Coleman et al., 2004). In these data, it was not possible to distinguish patients who died on the day of diagnosis (true zero survival) from those whose date of diagnosis was simply unknown, because they were registered on a death certificate only (DCO), but it is likely that the great majority of such cases were DCOs. The vital status of another 2% of patients was unknown on 5 November 2002, when the data were extracted for analysis, and leukaemia was not the first primary malignancy for a further 3.5% of patients; both groups were also excluded from analysis.

After a steady long-term increase, the incidence of leukaemia in England and Wales reached a plateau in the early 1990s at approximately 10 per 100 000 per year in men and 7.5 in women. The rise in incidence was less steep among more deprived groups, leading to lower incidence than among the more affluent groups of the population, particularly for men.

SURVIVAL TRENDS

For leukaemia patients diagnosed at the end of the 1990s, relative survival at 1 year was approximately 60%, whereas 5-year survival was 36% (women) or 40% (men; Table 1). Among men, 5-year survival increased significantly by approximately 5% every 5 years between 1986 and 1999, after adjustment for changes in the distribution of incident cases by deprivation category (Figure 1). For women, increases in survival since the late 1980s have been smaller and the pace of increase in survival every 5 years was not statistically significant. Survival among women is generally lower than for men, although 10-year survival is similar in the two sexes.

Hybrid analysis of the survival probabilities observed during 2000–2001 (Brenner and Rachet, 2004) reflects the continuing increase, but even for patients diagnosed around that time, relative survival at 5 and 10 years will still only reach approximately 40 and 30%, respectively.

DEPRIVATION

The deprivation gap in survival from leukaemia in adults is consistently and significantly in favour of the more affluent groups (Table 2, Figure 2). The fitted difference between the most affluent...
and most deprived groups in survival up to 5 years has been at least 5%, with slightly smaller differences in 10-year survival. For adults diagnosed with leukaemia during the late 1990s, 1-year survival was approximately 6% higher for the most affluent fifth of the adult population than for the most deprived fifth, in both sexes, with 5-year survival 3–4% higher.

For the cohort of men diagnosed with leukaemia during the early 1990s, the deprivation gap in survival at 1, 5 and 10 years after diagnosis seemed substantially wider than for men diagnosed in the late 1980s, but over the whole 14-year period 1986–1999, no consistent change in the deprivation gradient occurred. Among women, there is some evidence of shrinkage of the deprivation gradient in survival, particularly at 5 years (Table 2).

Short-term predictions based on hybrid analysis to predict the likely socioeconomic differences in survival for patients diagnosed during 2000–2001 do not suggest any imminent reduction in the deprivation gap (Table 2).

### Table I  Trends in relative survival (%) by sex, time since diagnosis and calendar period of diagnosis: England and Wales, adults (15–99 years) diagnosed during 1986–1999 and followed up to 2001

| Calendar period of diagnosis* | Time since diagnosis | Survival (%) | 95% CI | Survival (%) | 95% CI | Survival (%) | 95% CI | Survival (%) | 95% CI |
|-------------------------------|----------------------|--------------|--------|--------------|--------|--------------|--------|--------------|--------|
| 1986–1990                    | 1 year               | Men          | 56.7   | (55.6, 57.7) | 60.0   | (59.1, 60.9) | 61.9   | (60.9, 62.9) |
|                              |                      | Women        | 52.8   | (51.7, 53.9) | 55.6   | (54.5, 56.6) | 57.3   | (56.1, 58.4) |
| 1991–1995                    | 5 years              | Men          | 30.7   | (29.6, 31.7) | 35.3   | (34.3, 36.3) | 39.7   | (38.4, 41.0) |
|                              |                      | Women        | 30.0   | (28.9, 31.1) | 34.5   | (33.3, 35.6) | 35.9   | (34.4, 37.3) |
| 1996–1999                    | 10 years             | Men          | 21.1   | (20.1, 22.1) | 25.8   | (24.6, 27.0) | 28.6   | (27.6, 30.4) |
|                              |                      | Women        | 21.8   | (20.7, 22.9) | 27.3   | (26.0, 28.6) | 28.6   | (26.8, 30.4) |

*CI = confidence interval. Average change (%) predicted every 5 years, adjusted for deprivation.  Survival estimated with cohort or complete approach (1986–1990, 1991–1995, 1996–1999) or hybrid approach (2000–2001) (see Rachet et al., 2008). *P<0.05; **P<0.01.
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Table 2. Trends in the deprivation gap in relative survival (%) by sex, time since diagnosis and calendar period of diagnosis: England and Wales, adults (15–99 years) diagnosed during 1986–1999 and followed up to 2001

| Time since diagnosis | Calendar period of diagnosis | 1986–1990 | 1991–1995 | 1996–1999 | Average change (%) every 5 years | Prediction* for patients diagnosed during 2000–2001 |
|----------------------|-----------------------------|-----------|-----------|-----------|-------------------------------|-----------------------------------|
|                      | Depprivation gap (%) | 95% CI    | Depprivation gap (%) | 95% CI    | Depprivation gap (%) | 95% CI    | Depetration gap (%) | 95% CI    |
| 1 year               | Men                        | −5.7**   | (−8.7, −2.8) | −9.5***  | (−12.2, −6.8) | −6.0**  | (−9.0, −3.1) | −0.2    | (−2.4, 2.0) | −0.6**  | (−10.2, −1.9) |
|                      | Women                      | −7.8**   | (−11.2, −4.5) | −6.4**   | (−9.3, −3.3) | −5.8**  | (−9.1, −2.5) | 1.1     | (−1.4, 3.6) | −9.2**  | (−13.9, −4.5) |
| 5 years              | Men                        | −5.5**   | (−8.6, −2.5) | −9.6**   | (−12.5, −6.7) | −4.6**  | (−8.3, −0.5) | 0.0     | (−2.5, 2.6) | −3.8    | (−8.3, 0.8)  |
|                      | Women                      | −6.1**   | (−9.4, −2.8) | −4.9**   | (−8.1, −1.7) | −2.5    | (−6.7, 1.6) | 1.8     | (−0.9, 4.6) | −4.8    | (−9.7, 0.2)  |
| 10 years             | Men                        | −2.3     | (−5.3, 0.7)  | −7.2**   | (−10.7, −3.8) | −4.5*   | (−9.5, −0.3) | −2.4    | (−7.1, 2.4) | −0.3    | (−6.5, 3.9)  |
|                      | Women                      | −3.7*    | (−6.9, −0.4) | −3.3     | (−7.1, 0.4)  | 0.4     | (−4.7, 5.3) | −3.3    | (−8.5, 1.9) |

Cl = confidence interval. *Survival estimated with cohort or complete approach (see Rachet et al. 2008). **Mean absolute change (%) in the deprivation gap in survival every 5 years, adjusted for the underlying trend in survival (see Rachet et al. 2008). *Survival estimated with hybrid approach (see Rachet et al. 2008). *p<0.05; **p<0.01.

COMMENT

The main limitation of these analyses is that population-based survival trends could not be produced for the specific subtypes of leukaemia defined by recent clinical classifications, although overall survival trends among adults have been broadly similar for all the main types of leukaemia (Berrino et al., 1995, 1999; Coleman et al., 1999, 2004).

Despite therapeutic progress, however, the trends and socioeconomic patterns in survival from leukaemia in adults provide a striking contrast with those for leukaemia in children. Survival from all leukaemias combined in adults has improved steadily, but not rapidly, reaching approximately 40% 5-year survival for adults diagnosed by the end of the 1990s, and the deprivation gradient in survival is marked and persistent for both men and women.

For children with leukaemia, in contrast, the increase in survival since the 1970s has been dramatic, 5-year survival reaching 80% by the end of the 1990s. Furthermore, there is no significant socioeconomic gradient in survival, whether for all the leukaemias combined or for acute lymphoblastic leukaemia in particular (Stillier and Eaton, 1994; Coleman et al., 1999; Schillinger et al., 1999).

The disparities in the trends and socioeconomic inequalities in survival from leukaemia between children and adults are remarkable, and they merit further exploration.

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