

Incorporating Stillbirths and Neonatal Deaths Into the GBD

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This presentation draws on my collaboration with Julian Jamison, Joy Lawn, Sonbol Shahid-Salles and Jelka Zupan. Ken Hill and Cindy Stanton have contributed much to my thinking and to the literature.

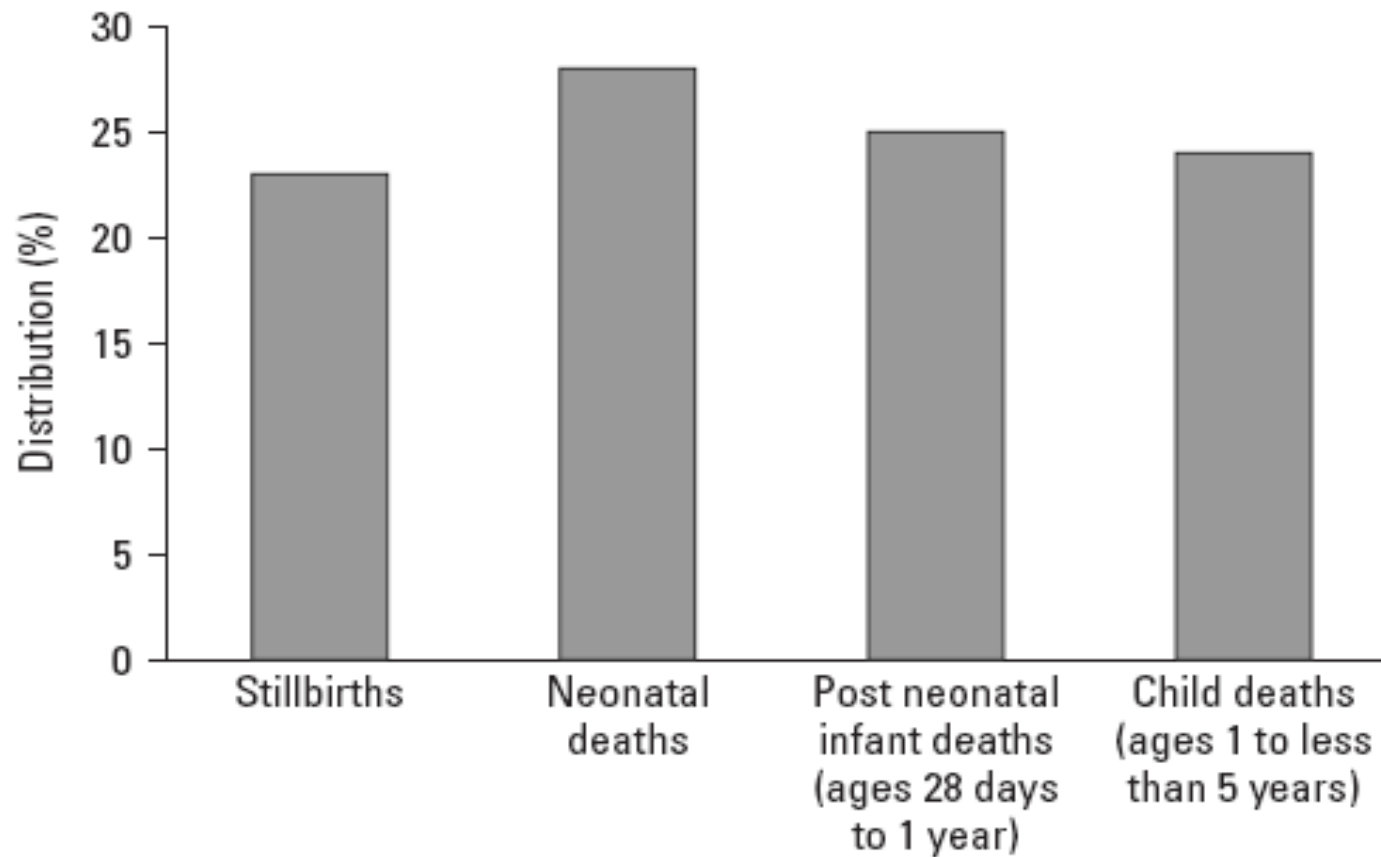


Table 6.1 Population Totals and Numbers of Births, 2001
thousands

| Region | Population (mid-2001) | Live births | Stillbirths | Total births |
|----------------------------------|-----------------------|-------------|-------------|--------------|
| Low- and middle-income countries | 5,221,572 | 118,505 | 3,228 | 121,733 |
| High-income countries | 928,660 | 11,371 | 45 | 11,416 |
| World | 6,150,233 | 129,876 | 3,274 | 133,150 |

Sources: Population is calculated from United Nations Population Division 2003, table 1. Live births are calculated from population totals and crude birth rates in World Bank 2003. Stillbirths are calculated from live births, using rates from WHO 2005a.





Source: Table 6.2.

Figure 6.1 Age Distribution of Deaths of Children under Five in Low- and Middle-Income Countries, 2001



Table 6.2 Age Distribution of Deaths under Age 5, 2001
thousands

| Region | Stillbirths | | Neonatal deaths | | | Deaths ages 28 days to < 1 year | Infant deaths (0 ≤ age < 1 year) | Child deaths (1 ≤ age < 5 years) | Deaths under age 5 | | |
|--------------------------------------|-------------|-------------|-----------------|--------------------|-------------------|---------------------------------------|--|--|--------------------|--|-------------------------|
| | Antepartum | Intrapartum | Total | Early ^a | Late ^a | | | | Total | After live birth (0 ≤ age < 5 years) | Including stillbirth |
| | a | b | c (a + b) | d | e | f (d + e) | g | h (f + g) | i | j (h + i) | k (j + c) |
| Low- and middle- income countries | 2,152 | 1,077 | 3,228 | 2,889 | 965 | 3,854 | 3,745 | 7,599 | 2,935 | 10,530 | 13,758 |
| High-income countries | 40 | 5 | 45 | 32 | 9 | 41 | 18 | 59 | 13 | 73 | 119 |
| World | 2,192 | 1,082 | 3,274 | 2,921 | 974 | 3,896 | 3,762 | 7,658 | 2,948 | 10,602 | 13,876 |

Sources: Columns a, b, c, d, e, and f are calculated from rates provided by WHO 2005a, using live birth totals from table 6.1 of this chapter. Column j is from chapter 3 of this volume. Column h = (infant mortality rate/under-five mortality rate) × total number of deaths from column j. Column i = [(under five mortality rate – infant mortality rate)/under five mortality]; under five mortality rates are from the World Bank (2003, table 2.20). The World Bank under five mortality rates are very close to, but not identical with, those reported in this volume (chapter 2, table 2.3). The World Bank numbers are used because they are accompanied by a consistently generated set of infant mortality rates.

a. The early neonatal period extends from birth to under 7 days of age; the late neonatal period extends from 7 days to under 28 days.



Table 6.3 Estimated Death Rates under Age 5, by Country Income Level, 2001
Probability of dying in the x years following age y (${}_xq_y$), expressed per thousand live births

| | Stillbirth rate (${}_{0.25}q_{-0.25}$) | Neonatal mortality rate (${}_{.077}q_0$) | Under 1 mortality rate (${}_1q_0$) | Complete under 1 mortality rate (${}_{1.25}q_{-.25}$) | Child mortality rate (${}_4q_1$) | Under 5 mortality rate (${}_5q_0$) | Complete under 5 mortality rate (${}_{5.25}q_{-.25}$) |
|----------------------------------|---|---|---|--|---------------------------------------|---|--|
| Region | a | b | c | d | e | f | g |
| Low- and middle-income countries | 27 | 33 | 64 | 89 | 25 | 89 | 113 |
| High-income countries | 4 | 4 | 5 | 9 | 1 | 6 | 10 |
| World | 25 | 30 | 58 | 82 | 23 | 82 | 104 |

Sources: Columns c and f are based on data from the World Bank (2003, table 2.20). Data for columns a, b, d, e, and g are provided by WHO (2005a).

Note: Column a = (total stillbirths)/(total births). Column b = (neonatal deaths)/(live births). Column c = (infant deaths)/(live births). Column d = (infant deaths + stillbirths)/(total births). Column e = (total deaths from ages one to four years)/(live births). Column f = (total deaths under age five)/(live births). Column g = (total deaths under age five including stillbirths)/(total births).

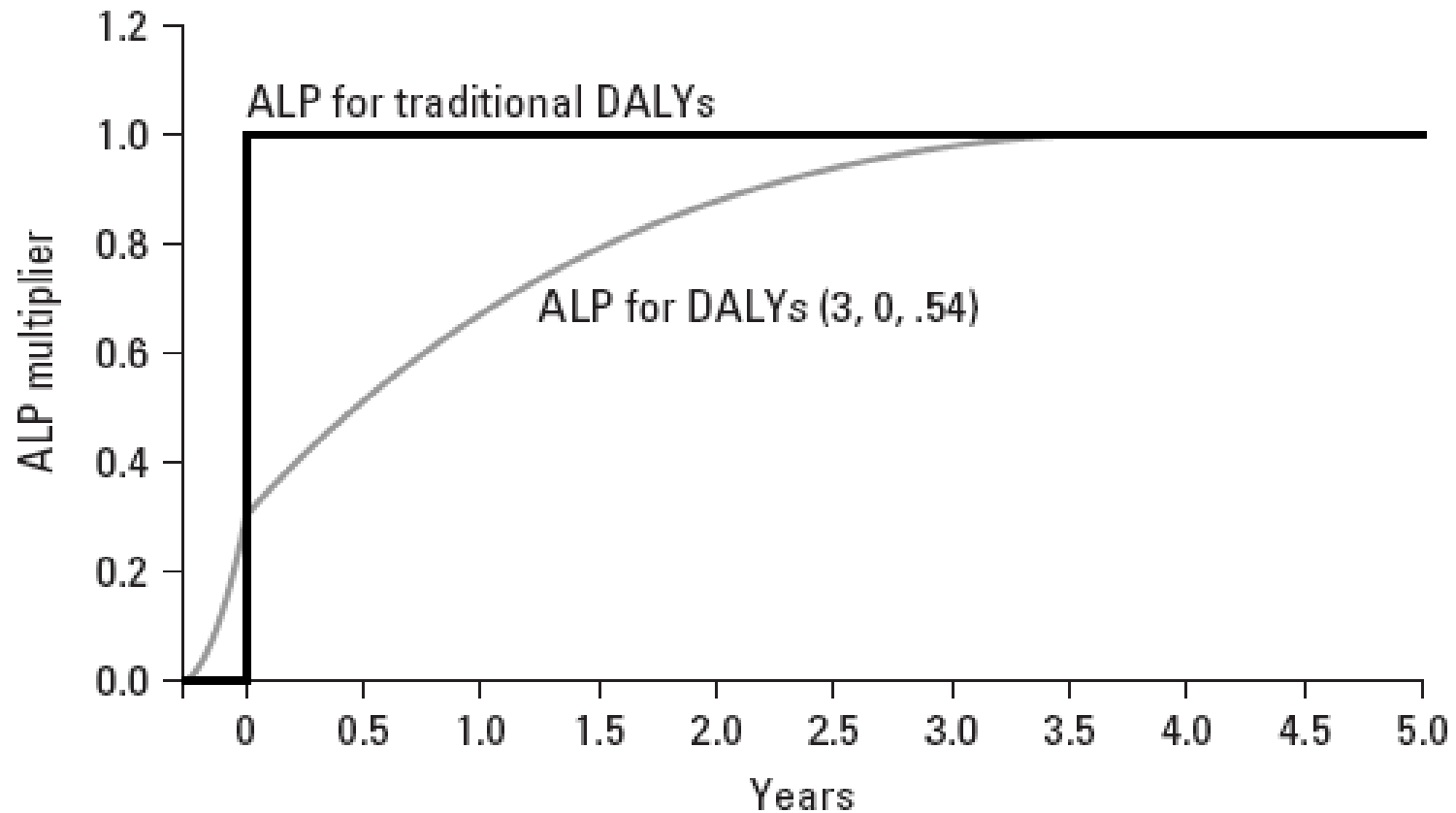


Three Conceptual Problems with DALYs

1. DALYs ignore stillbirths
2. The loss function has an abrupt discontinuity
3. By construction, the DALY loss from a death at age 1 day must be close to that from a death at age 20 years (for any reasonable values of r and k)

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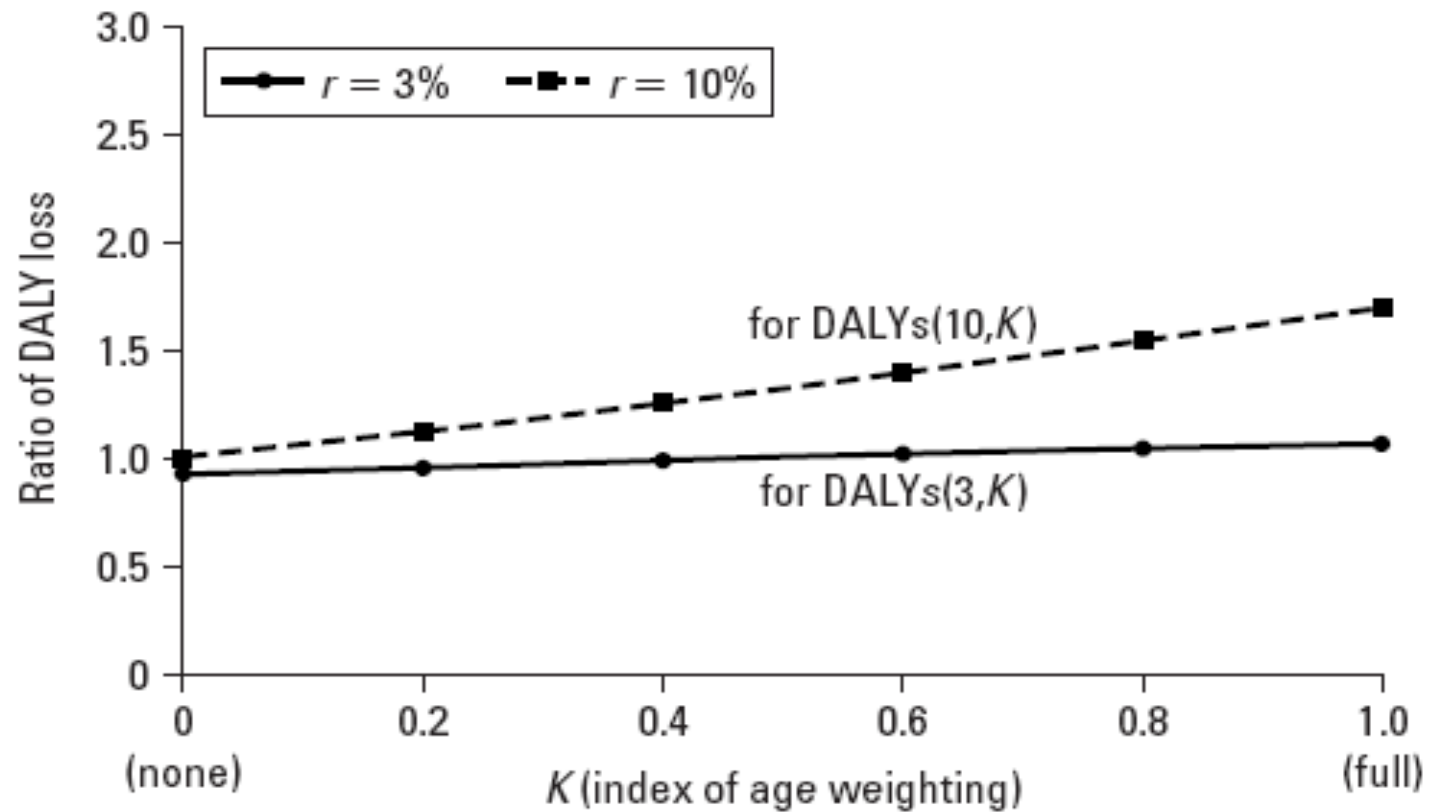




Source: Authors' calculations.

Figure 6.2 ALP, Traditional DALYs, and DALYs (3,0,.54)





Source: Authors' calculations.

Figure 6.3 Ratio of DALYs Lost at Age 20 to Age 0 as a Function of Age Weighting



$$L(a) = f(a) \int_a^{\infty} Cx e^{-\beta x} e^{-r(x-a)} s_a(x) dx$$



$$f(t) = \begin{cases} f_-(t) = f^0(4t + 1)^{1/(1-g)} \\ \quad (\text{for } -0.25 \leq t < 0) \\ \\ f_+(t) = 1 - (1 - f^0) [(T - t)/T]^{1/(1-b)} \\ \quad (\text{for } 0 \leq t \leq T). \end{cases}$$



Table 6.5 Values of Selected ALP Functions

| (a) t (age) | (b) $f_D(t)^a$ | (c) $f_{DSB}(t)^b$ | (d) $f_1(t)$ | (e) $f_2(t)^c$ | (f) $f_3(t)$ |
|----------------|-------------------|-----------------------|-----------------|-------------------|-----------------|
| -0.25 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 |
| -0.08 | 0.00 | 1.00 | 0.12 | 0.16 | 0.30 |
| 0.00 | 1.00 | 1.00 | 0.25 | 0.30 | 0.50 |
| 0.02 | 1.00 | 1.00 | 0.25 | 0.31 | 0.52 |
| 0.08 | 1.00 | 1.00 | 0.26 | 0.34 | 0.59 |
| 0.25 | 1.00 | 1.00 | 0.29 | 0.41 | 0.74 |
| 0.30 | 1.00 | 1.00 | 0.30 | 0.43 | 0.78 |
| 0.50 | 1.00 | 1.00 | 0.34 | 0.51 | 0.88 |
| 1.00 | 1.00 | 1.00 | 0.41 | 0.67 | 0.98 |
| 2.00 | 1.00 | 1.00 | 0.55 | 0.87 | 1.00 |
| 3.00 | 1.00 | 1.00 | 0.66 | 0.97 | 1.00 |
| 5.00 | 1.00 | 1.00 | 0.83 | 1.00 | 1.00 |

Source: Authors' calculations.

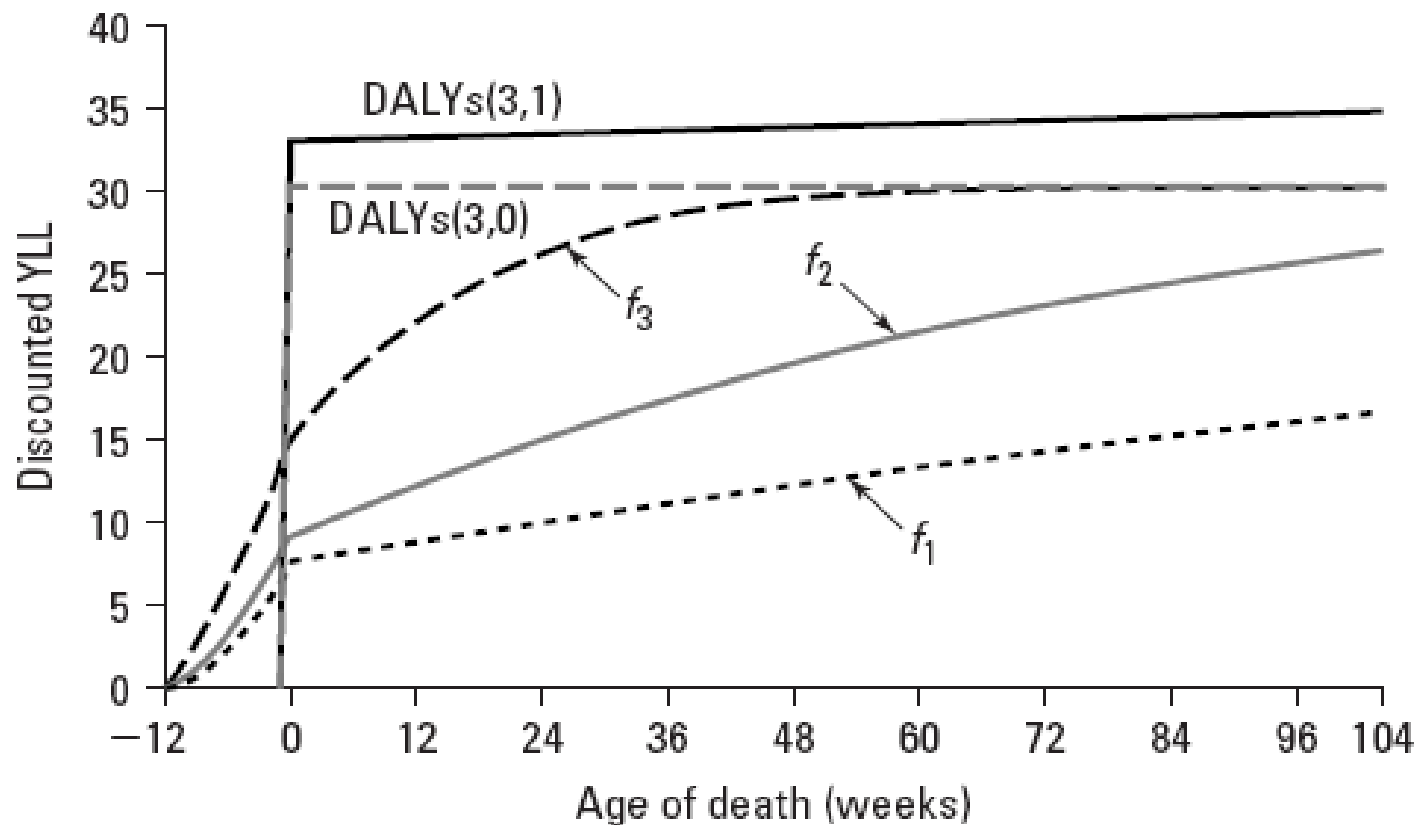
a. $f_D(t)$ is the traditional DALY formulation that is, stillbirths are not incorporated, and ALP is instantaneous.

b. $f_{DSB}(t)$ is the traditional DALY formulation extended to give equal weight to stillbirths as to deaths at age 0, that is, it leads to $DALY_{DSB}(3,0,1)$.

c. $f_2(t)$ is the ALP function used to generate the $DALY_{SG}(3,0,.54)$ GBD estimates reported in table 6B.8. These are DALYs that incorporate stillbirth and gradual ALP.



a. Stillbirth to age 2

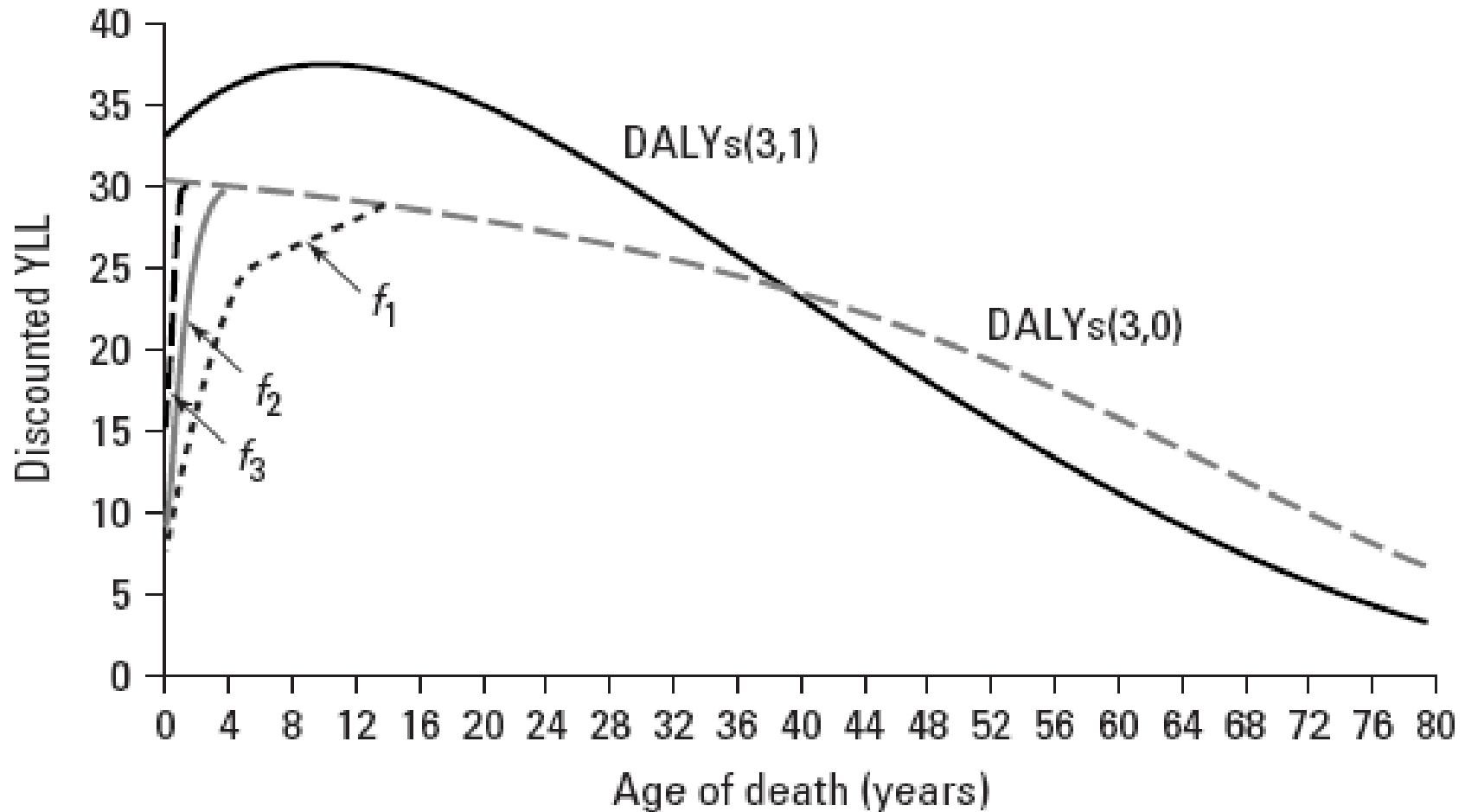


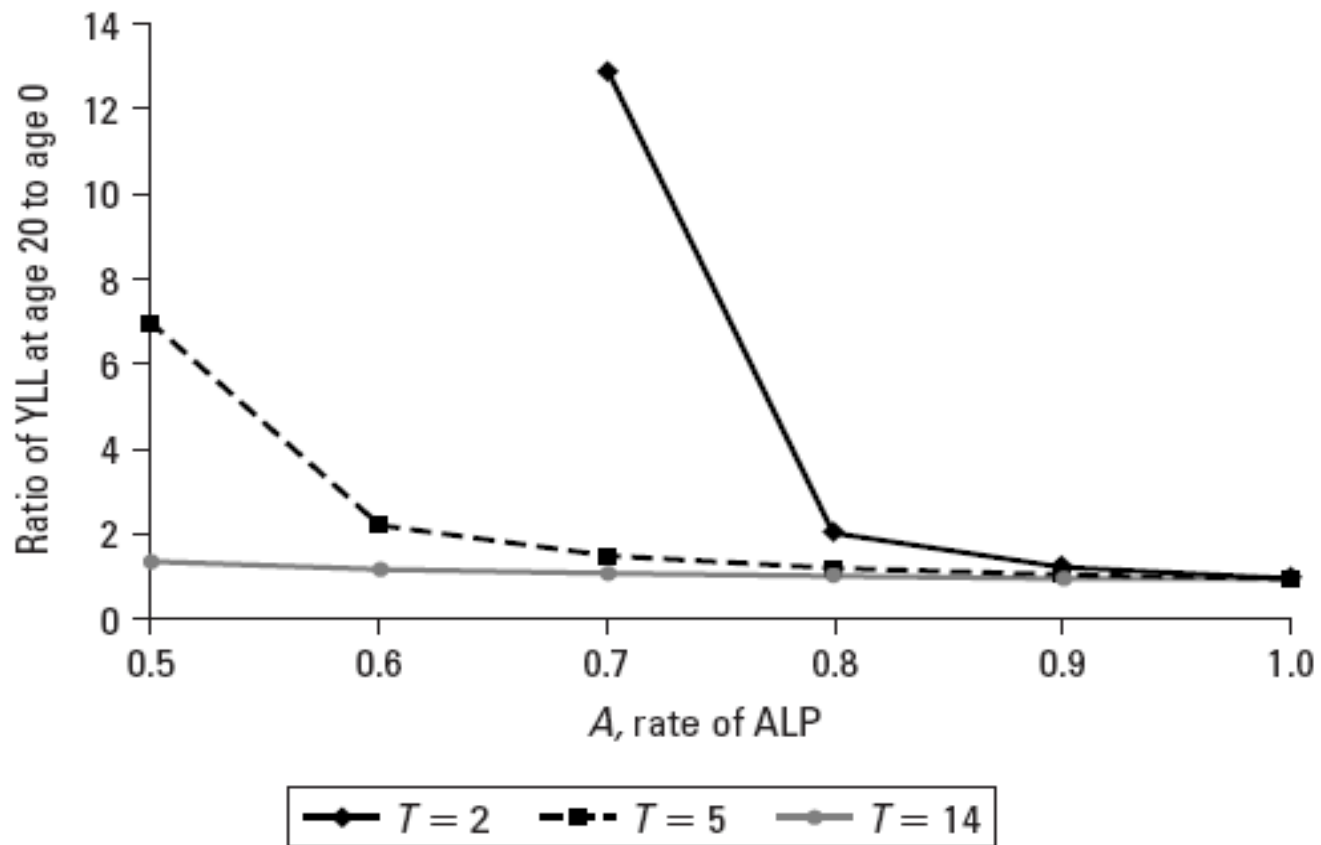
Source: Authors' calculations.

Figure 6.4 YLL for Deaths at Different Ages



b. Birth to age 80





Source: Authors' calculations.

Note: A is rate of ALP. T is the time to complete acquisition of life potential.

Figure 6A.2 Ratio of DALYs Lost at Age 20 to Age 0 as a Function of A

