ג'וינט ישראל
מכון ברוקדיל לגרונטולוגיה
והתפתחות אדם וחברה בישראל

JOINT (J.D.C.) ISRAEL
BROOKDALE INSTITUTE OF GERONTOLOGY
AND ADULT HUMAN DEVELOPMENT IN ISRAEL

ON THE SEX-DIFFERENTIAL INCIDENCE OF WIDOWHOOD

discussion paper

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On the Sex-Differential
Incidence of Widowhood

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Abstract

This paper analyses the determinants of widowhood and the causes of differences between men and women in the incidence of this status. Women tend to live longer than men and this is generally given as the reason for finding a larger proportion of widows than widowers. There is, however, a second cause: uneven age at marriage. Many women marry older men, so that even if the lifespans of both spouses were equal, an average woman still lives beyond her husband for a period equal to the age difference upon marriage.

These two causes have entirely different natures; the first cause is believed to be basically biological, whereas the second is behavioral. Thus an examination of the relative contribution of the two factors reveals what part of the sex-differential pattern is "imposed by nature" and which part results from human preference. The analysis formulates a model, applies it to simulation experiments and then proceeds to an empirical test of the model. The conclusions show that the primary cause of sex differentials in widowhood is the age gap between husband and wife, rather than the longer lifespan of women.

TABLE OF CONTENTS

LIST OF TABLES

1. Introduction

Widowhood is strongly connected with loneliness, with all its implications for wellbeing.[1/] Since this family status is highly correlated with age, it is frequently discussed by gerontologists, who look at it mainly from the point of view of the results, less so from the perspective of cause. The aim of this paper is to analyse the determinants of widowhood and the causes of differences between men and women in the incidence of this status.

The usual statement made in this context is that women tend to live longer than men, therefore a larger proportion of widows than widowers is expected.[2/] While this is true, it is not the only truth. There is another cause for differences in the incidence of widowhood between men and women, namely uneven age at marriage. On the average, women tend to be younger than their husbands; so, even if the lifespan of both spouses is equal, they end with the woman living after her husband's death for a period equal to their age difference at marriage. The greater percentage of widows than widowers is therefore due to two factors: (1) the longer lifespan of women and (2) the lower age of women at marriage. Separating the two factors from one another is not mere classification. These two causes are of an entirely different nature; the first cause is believed

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1/ See, for example, Mervyn Susser, "Widowhood: A Situational Life Stress or a Stressful Life Event?" American Journal of Public Health, August, 1981.

2/ See, for example, George Masnick and Mary Jo Barre, The Nation's Families: 1960-1990, Auburn House Publishing Company, Boston, 1980, pp. 30-34.

to be basically biological,[3] whereas the second is basically behavioral. Analysing the relative contribution of the two factors will reveal which part of the sex-differential pattern is "imposed by nature" and which part is a result of human preferences. The analysis will begin by formulating a model, which then will be applied to some simulation experiments, followed by an empirical test of the model. The analysis will show that the main cause for sex differentials in widowhood is the age gap between husband and wife rather than the commonly-stated cause of women's longer lifespan.

2. The Model

A calculation of the rate of widowhood caused by each of the above-mentioned factors starts with the "basic rate". If we want to calculate how many more widows there will be due to the longer lives of women, the first component of the calculation must relate to the term "more": more than what? Obviously, this will not be zero, since even with equal average life span and even ages for both spouses, the probability that both spouses of a specific couple will die together is smaller than the the probability that only one of them will die in a given year. Suppose that there is a population of size 2A at the beginning of a year, half of whom are men and half women, all married, and the annual death

[3] There are some theories that women's shorter lifespan is influenced by the fact that they are more vulnerable to illnesses that result from work stress. The claim is made that the higher labor force participation rates might expose women to risks similar to those that men face. However, the prevailing approach is that the phenomenon primarily results from biological differences.

rate is d for both sexes. The number of men (and women) surviving at the end of one year will be:

(1) $$P = A \cdot S$$

where S is the survival rate $(S = 1 - d)$.

The probability that a person will remain <u>married</u> is equal his/her survival probability multiplied by the probability of his/her spouse surviving. Thus the number of married men at the end of one year will be:[4/]

(2) $$MR = A \cdot S^2$$

[4/] This can also be specified as:

$$MR = A \cdot (1 - d)^2 = A(1 - 2d + d^2)$$

which means that the number who will remain married out of population A will decrease by two times the death rate multiplied by A, <u>plus</u> the square of the death rate. The latter component expresses the fact that of those dying during that period there is some portion which will not cause widowhood in the opposite sex, since <u>both</u> spouses will die during that period. The probability of such a case is equal to the product of the death rates of both spouses. Since death rates are assumed to be equal for both sexes, the probability becomes the square of the death rate, d^2. For example, suppose population A, consisting of 1000 married men, is exposed to an annual death rate of 0.1. The number of men remaining married after one year will be $1000(0.9)^2$ according to the text equation, and $1000(1 - 2 \times 0.1 + 0.1^2)$ according to the second equation. Both calculations generate the same result of 810 men remaining married, which implies that the first version embodies the d^2 component, i.e., the case of both spouses dying in the same period.

and the proportion of married men in this cohort will be:

$$\frac{MR}{P} = \frac{A \cdot S^2}{A \cdot S} = S \tag{3}$$

More generally, for time t:

$$\frac{MR_t}{P_t} = \frac{A \cdot S^{2t}}{A \cdot S^t} = S^t \tag{4}$$

The rate of widowers, W_t, will be the complement of the above:

$$\frac{W_t}{P_t} = 1 - S^t \tag{5}$$

which means an ever-increasing share of widowers, the rate of increase depending on the death rate d. Using a numerical example and the above assumptions, with an average annual death rate of 0.1, after 7 years there will be $(1 - 0.9^7)$, or 52 percent of the model population will be widowed.

In order to come closer to reality one should use increasing death rates instead of a constant one. But this will change the formulation only slightly, as follows:

$$\frac{MR_t}{P_t} = \frac{A \cdot S_1^2 \cdot S_2^2 \cdot S_3^2 \cdots S_n^2}{A \cdot S_1 \cdot S_2 \cdot S_3 \cdots S_n} = \prod_{i=1}^{t} S_i \tag{4'}$$

and for the rate of widowhood:

$$\frac{W_t}{P_t} = 1 - \Pi S_i \tag{5'}$$

We have demonstrated that there is a "basic rate of widowhood",

meaning that some basic rate of widowhood exists even with no cross-sexual difference in lifespan and age at marriage; its size depends on the death rate.

We now release some of the above restrictions so as to measure each factor's contribution to the difference between men and women with respect to the incidence of widowhood. Let us first consider the hypothetical case of men and women who are, on the average, married at the same age, and where the death rates of women are lower than for men. In this case the notation must be changed to distinguish between female and male death rates, D_f and D_m respectively. Normally, we find $D_{f,t} < D_{m,t}$ at each age.

The probability of remaining married after one year is the product of the survival rates of both spouses; thus the number of those who remain married after one year is (equally for men and women) as follows:

$$MR_{f,1} = MR_{m,1} = A(S_{m,1} \cdot S_{f,1})$$

This provides the <u>absolute</u> number. To obtain the <u>proportion</u> married for each sex, we calculate a quotient where the above is the nominator and the denominator is the total survivors of each sex: the proportion is $\frac{MR_t}{P_t}$. The total number of surviving females is, however, larger than the number of men, so that in spite of equal nominators for both sexes, the denominator of the quotient for women is larger than for men $(P_{f,1} > P_{m,1})$. Hence:

$$\frac{MR_{f,1}}{P_{f,1}} < \frac{MR_{m,1}}{P_{m,1}}$$

By how much will the rate of female widowhood exceed the rate for males? Consider the case of constant death rates for each age. Simplifying the notation to F and M for the rates of widowhood, female and male respectively, we derive:

$$(6) \qquad F_1 = \frac{A(S_f \cdot S_m)}{A(S_f)} = S_m$$

and

$$(7) \qquad M_1 = \frac{A(S_f \cdot S_m)}{A(S_m)} = S_f$$

which means that the "rate of remaining married" (hereafter referred to as the "married rate") for each sex equals the survival rate of the opposite sex. If we extend the period from one year to n years, then:

$$(8) \qquad F_n = \frac{A(S_f \cdot S_m)^n}{A(S_f)^n} = S_m^n$$

$$(9) \qquad M_n = \frac{A(S_f \cdot S_m)^n}{A(S_m)^n} = S_f^n$$

Thus, the ratio between the two rates of remaining married for women and men is:

$$\frac{F_n}{M_n} = \frac{S_m^n}{S_j^n}$$

i.e., the reciprocity of their survival rates. A further step towards reality introduces age-progressive death rates, which means for each age

t there is an age-specific survival rate S_t. In that case, (8) and (9) become:

$$(8') \qquad F_n = \prod_{t=1}^{n} S_{m,t}$$

and

$$(9') \qquad M_n = \prod_{t=1}^{n} S_{f,t}$$

This merely means a product of a vector instead of a power of a scalar.

The final step towards reality assumes a graduation of age at marriage between sexes. Suppose we have an average age difference of three years between the spouses; the married rate for women after three years will then be:

$$F_2 = \frac{A(S_{f,1} \cdot S_{m,4})(S_{f,2} \cdot S_{m,5})}{A(S_{f,1} \cdot S_{f,2})} = S_{m,4} \cdot S_{m,5}$$

and similarly for men. Generalizing for a difference of i years at age of marriage we obtain:

$$(8'') \qquad F_n = \prod_{t-1}^{n} S_{m,t+i}$$

and

$$(9'') \qquad M_n = \prod_{t=1}^{n} S_{f,t-i}$$

We can now reduce the difference in marital status to two components. The "neutral" ratio between the rates of married women and men is the one obtained in the case of equal death rates for both sexes and equal

age at marriage. This is a special case of (8) and (9) where $S_f = S_m$, so that:

$$(10) \qquad \frac{F_n}{M_n} = \frac{S_m^n}{S_f^n} = 1$$

In the case of higher death rates for men, but assuming equal age at marriage, the ratio between the married rates between women and men after n years will be:

$$(11) \qquad \frac{F_n}{M_n} = \frac{\prod_{t=1}^{n} S_{m,t+1}}{\prod_{t=1}^{n} S_{f,t-1}}$$

In order to evaluate the relative contribution of each factor, let us consider a hypothetical cohort of 1,000 men and 1,000 women at age 64, all of them married. The death rates given are the Israeli death rates for 1978 and yield the following survival rates:

Age	Male	Female
65-69	0.967	0.977
70-74	0.951	0.962
75-79	0.922	0.936

In the first case of equal age at marriage, according to (8) and (9), at the age of 74 we get a ratio of:

$$\frac{F_{10}}{M_{10}} = \frac{0.66}{0.73} = 0.90$$

Thus, lower death rates among women cause a decrease of 10 percent in the "equality" of the sexes with respect to their remaining married.

In the second case, where there is an age difference at marriage and women are on the average younger than their spouse by, suppose, five years, the ratio will be:

$$\frac{F_{10}}{M_{10}} = \frac{0.52}{0.89} = 0.58$$

This means that the second factor causes a further decrease of the equality to 0.58. Thus age difference at marriage is responsible for most of the inequality of marital survival, its effect exceeding by far the effect of the "biological" factor of lower death rates among women.

3. Simulation Results

The above analysis enables us to measure the relative importance of age gap and comparative lifespan in explaining differences in marital status between men and women. It shows that the first factor is more important inasmuch as the ratio between successive death rates exceeds the ratio between sex-specific rates at a given age. A more precise evaluation of the relative contributions of the two factors is obtained from the following experimental simulations.

(a) Hypothetical simulation

The first simulation takes a hypothetical starting point of an equal number of men and women, age 64 and all married. Actual death rates from the Israeli population are applied under three alternative assumptions:

Table 1: Percent Married Under Three Alternatives, Using a Hypothetical Equal Distribution of Men and Women at Age 64

Age	Alternative I equal age		Alternative II(1) wife younger one year		Alternative II(2) wife younger three years	
	Men	Women	Men	Women	Men	Women
64	100	100	100	97	100	90
65	98	97	100	94	100	87
66	96	94	98	90	100	85
67	93	90	95	87	100	80
68	91	87	93	85	98	77
69	89	85	91	80	95	73
	---	---	---	---	---	---
70	86	80	89	76	93	70
71	82	76	85	73	91	68
72	79	73	82	69	89	64
	---	---	---	---	---	---
73	76	69	79	66	87	60

I. Both spouses are of the same age.

II. Women are younger than their spouses, on the average, by:

(1) one year, and

(2) three years.

The results are summarized in Table 1. In the first alternative the pattern of marital status starts from equality at age 64 and gradually develops a divergence between the two sexes; in terms of the ratio between the rates of married women versus married men it declines from 1 to 0.96 by the age of 69. The alternative of a one-year gap between spouses reduces the ratio at age 69 to 0.88. The third alternative, that of a three-year gap, brings the ratio further down to 0.77. In this alternative, at the age of 72 almost 90 percent of men are still married, whereas the corresponding proportion of married women is 64 percent. The age gap factor in this case is responsible for most (three-quarters) of the inequality in the probability of remaining married.[5]

(b) Realistic simulation

The second simulation (Table 2) is based on actual--though estimated[6]--

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[5] The effect of each factor is calculated as follows:

"Neutral" ratio	1.
(assuming equal age and death rates)	
Ratio assuming sex-differential death rates (73÷79=)	.924
(alternative I)	
Real ratio (alternative II (2)) (73÷95=)	.720

Total inequality declines by 28 percent, of which (20.4 ÷ 28=) 73 percent is caused by the age graduation factor.

[6] The data are from the 1972 census. For simplicity, the size of the cohort is assumed to be a fifth of the 65-69 age group, and its composition is taken from that age group.

Table 2: Calculation of Percent Remaining Married Under Alternative Age Gap Assumptions: Based on Actual Cohort Size and Composition

Age	Alternative I equal age		Alternative II(1) wife younger five years		Alternative II(2) wife younger six years	
	Men (1)	Women (2)	Men (3)	Women (4)	Men (5)	Women (6)
65	88	84	88	65	90	62
66	86	81	87	62	88	59
67	84	78	86	59	87	56
68	82	76	85	56	86	53
69	80	73	84	53	85	49
	--	--	--	--	--	--
70	77	70	82	49	84	45
71	74	66	80	45	82	42
72	71	63	78	42	80	38
73	68	60	76	39	78	35
74	66	57	75	36	76	31

data on a cohort that was 64 years old in 1972. This cohort consisted of 980 men (878 of whom were married) and 1,013 women. In this simulation the proportion of married men at the starting point, age 64, is not 100 percent, as in the previous simulation; it is rather the actual rate of 90 percent for men aged 64. The first alternative used the hypothetical assumption of equal age at marriage. The simulation brings the married rate for men down by 2 percent per annum until it reaches 80 percent at age 69; it then enters a more rapid phase and falls to 66 percent at age 74. The corresponding figures for women are 93 percent at age 69, yielding a ratio of 0.91 between female and male widow/ers, and 57 percent at age 74, with a female/male ratio of 0.86.

Compare these results to alternatives that take into account some gap between the ages of husband and wife. One alternative version employed an average age gap of five years. This reduced the downslope of the male rate, decreasing it only to 84 percent still married at age 69 (compared to 80 percent in the no-age gap experiment), and to three-quarters of all men at age 74 (compared to only two-thirds previously). There is an adverse effect for women; they begin at age 65 with much lower rate (two-thirds married), decline to almost fifty percent married at age 69, and to only one-third married at age 74. The ratio thus obtained between women and men goes down to 0.63 at age 69 and to 0.48 at age 74.

The last stage introduces another actual information on the age gap into the calculation. A survey conducted in the second half of the 1970s found a median age difference of 6.5 years between elderly (age 65+) spouses. We therefore tried another version of the simulation, using an

age gap of six years (an integer approximation to the actual 6.5 years).[7]

Two interesting points derive from the results of this last experiment:

(1) The results show the sensitivity to adding one year to the age gap.

(2) Parameters closer to the actual ones provide a performance test of the model.

Regarding the first point, Table 3 shows that at age 65, for example, the accumulated effect of lower death rates for women causes a reduction of nine percent in the equality of the two sexes with respect to marital status; this is reflected in the ratio of 91 percent at age 69 in the no-age gap column. The second column presents a ratio of 63 percent for this age, meaning that because of the (five year) age gap effect the ratio declined more steeply than it did when introducing sex-differentiated death rates alone. The same direction can be found at each age. Moving further towards reality, column (3) shows that using an age gap of six years decreases the ratio at age 74 to 41 percent, compared to 48 percent in the five year experiment. Thus adding one year to the age gap reduces equality by 7 percentage points.

The second point is that the results presented in columns (5) and

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[7] As may have been noticed earlier, while describing the actual basic cohort on which we conducted the experiment, it was stated that 878 of the men were married, but no reference was made to the number of women married. The number married of one sex was introduced as input, actual data on death rates and marriage age gaps was added, and the model then run to obtain the number married at each age. The number of married women so computed was indeed quite close to the actual figure, 646 computed versus 627 actual. Using the more accurate age gap of 6.5 years instead of six would narrow the discrepancy even further.

Table 3: Ratio Between Proportions Remaining Married Among Men and Women: Based on Table 2

Age	Alternative I (1)	Alternative II(1) (2)	Alternative II(2) (3)
65	95	72	69
66	94	71	67
67	93	68	65
68	93	66	62
69	91	63	58
70	91	60	53
71	89	56	51
72	88	54	47
73	88	51	45
74	86	48	41

(6) of Table 2 demonstrate the effectiveness of the model. This version assumes a six year age gap, which approximates the actual median age gap. The experiment also has the advantage of starting with the actual basic cohort size and distribution by sex and marital status. Similar tables can be constructed for all cohorts comprising the elderly population, which would enable one to calculate the average rates of widowhood for men and women. As a preliminary test it is, however, convenient to refer to the simple average of a group of ages as a proxy for the true average. The "simple" average so calculated yields an average of 84 percent married men in the 65-74 age group and 47 percent married women, which is close to the actual means found for this age group in the 1972 census, namely 86 percent for men and 45 percent for women.

4. Summary

As postulated in the introduction, referring to the longer lifespan of women as the cause for higher proportions of widows than of widowers discloses but one part of the picture and not the major part at that. The major component of the differential pattern stems from the frequent age gap between husband and wife. It was demonstrated with the Israeli figure of a median age gap of 6.5 years for the elderly population, at age 69, for example, that sex-differential death rates are responsible for only 9 percent of the "inequality" in widowhood, whereas spousal age gaps account for 28 percent more, decreasing the ratio between widowhood of women and men to 0.63. It might further be shown that even with a narrower age gap--which may characterize other Western societies--that this factor remains the major explanation for the larger proportion of widows than

widowers found elsewhere.

The introduction also mentions that the distinction between the two factors considered is not a mere technical distinction; it expresses the distributed effect of a biological difference (longer female lifespan) versus a behavioral preference. Therefore, inasmuch as there exists a social tendency to narrow the age gap, the ratio between the proportions of widows and widowers tends towards greater balance. The empirical evidence of the Israeli experience shows that the percent of elderly widows at age 65-74 went down from 55% in 1961 to 49% in 1972. The ratio between the proportions of widows and widowers has, thus, declined from 5.5 to 4.9. There was no narrowing of the life expectancy difference between men and women (if at all, a slight widening of the difference may be observed). The main factor operating in that period was, then, the narrowing spousal age gap that occured in the 1930s and early 1940s, and which took effect in the widowhood ratios of the 1960s and 1970s. This behavioral change reflects, partially at least, Westernization patterns among the groups that comprise Israeli society.

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בין גברים ונשים

דפי דיון

יעקב קופ

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על שיעורי התאלמנות נבדלים בין גברים ונשים

יעקב קופ

D-71-81

תקציר

שיעור האלמנות בין הנשים הקשישות גבוה במידה רבה משיעור האלמנים בקרב הגברים. בדרך כלל נוטים לייחס את ההבדל הזה לחובת העובדה שאורך החיים של גברים קצר מזה של נשים. הסבר זה הינו נכון, אך אינו ההסבר היחיד; גורם אחר הוא הפרש הגיל בין בני הזוג, כאשר נשים הן, בדרך כלל, צעירות מבני זוגן, ולכן אילו אורך החיים של גברים ונשים היה שווה גם אז היו נשים מוסיפות לחיות שנים מספר.

ניתוח חלקי של כל אחד משני הגורמים הללו להבדלים בשיעורי ההתאלמנות הוא בעל ענין החורג ממשמעות סטטיסטית גרידא, שהרי שני הגורמים הללו הם בעלי אופי שונה זה משה: הגורם האחד - אורך החיים הנבדל - הוא גורם ביולוגי ביסודו, בעוד שהגורם השני הוא התנהגותי.

ניתוח התרומה היחסית של כל אחד משני הגורמים יקבע, איפוא, איזה חלק מההבדל בדפוסי ההתאלמנות מוכתב על ידי חוקי הטבע ואיזה חלק מושפע מתהליכים חברתיים.

המאמר פותח בניתוח תיאורטי של הבעיה, ולאחר ניסוח מודל מתאים מוצגות כמה תוצאות של סימולציה שנערכה על בסיס המודל הזה. בסיום מובא שקלול הגורמים החושף את המסקנה כי הגורם העיקרי בהיווצרות דפוסי האלמנות הנבדלים נעוץ בהפרשי הגיל בנישואים ולא בהפרשים בשיעורי התמותה.

תוכן העניינים