

Research article

## The influence of age on the female/male ratio of treated incidence rates in depression

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### Abstract

**Background:** Poor data exist on the influence of psychosocial variables on the female/male ratio of depression because of the small number of cases and the resulting limited numbers of variables available for investigation. For this investigation a large number of first admitted depressed patients (N = 2599) was available which offered the unique opportunity to calculate age specific sex ratios for different marital and employment status categories.

**Methods:** Age and sex specific population based depression rates were calculated for first ever admissions for single year intervals. Moving averages with interpolated corrections for marginal values in the age distribution were employed.

**Results:** For the total group the female/male ratio of depression showed an inverted U-shape over the life-cycle. This pattern was influenced by the group of married persons, which showed a sex-ratio of 3:1 between the age of 30–50, but ratios of around 1:1 at younger and older ages. For not married persons the female/male ratio was already around 2:1 at the age of 18 and rose to 2.5:1 in mid-life and declined to 1 at around 55. The almost parallel decline of depression rates in employed men and women resulted in a female/male ratio of about 2:1 from age 18 to age 50 and became 1 after the age of 60. The female/male ratio among the not employed was about 1, in mid-life it became negative.

**Conclusions:** Our analyses show that the gender-gap in first admitted depressed patients is age dependent and that psychosocial factors modify the sex ratio.

### Introduction

In reviewing published studies on age specific sex differences in depression, Jorm [1] concluded that the broad claim that depression is more common in women than in men is an oversimplification. He found that an inverted U-shape of the age curve of the female/male depression ratios fit the data best, reflecting the finding that the dif-

ference between male and female rates are rather small in young age, increase towards mid-life and decrease thereafter.

More recent studies confirm this finding. Anthony and Petronis [2] have shown in an ECA-Follow-up study that the incidence rate of depression rises towards midlife in

women but not in men. In Australia, Wilhelm et al. [3] found an increasing female preponderance of life time prevalence in depression rates when following-up a cohort of 170 teacher trainees from age 23 (when the female/male ratio was about 1:1) to age 38, when it became 1.5:1. Jorm's observation of a narrowing down of the gender gap after mid-life is supported by the accumulating evidence that – contrary to common belief- depression in women becomes less frequent after the menopause [4–6]. Also, in the US National Comorbidity Survey (NCS) [7] which provides age specific 12 months prevalence rates in five year categories up to the age of 55, an increasing gender gap was found towards mid-life with a decrease thereafter. In the earlier Epidemiologic Catchment Area Study (ECA) hardly any gender difference was observed after the age of 55 [8]. Bebbington et al [9] in a representative survey also confirmed, that the female preponderance in depression is evident only before the age of 55 due to an absolute fall in female prevalences thereafter. Der and Bebbington [10] found a decreasing gender gap in first admission depressives after the age of 55 (55–64 = 1.3; 65–74 = 1.2; 75 += 1.0) and Meltzer et al. [11] reported for the British National Survey that after the age of 55 the sex ratio changes to a male preponderance. Beyond the ages of 65 and 75 the situation seems to be less clear. While some investigators did not observe any gender differences among the very old [12,13], recently Prince et al. [14] found a significant excess of women in a survey of 21.724 subjects from 11 countries aged 65 and over.

At first sight, age seems to offer an intriguing possibility to narrow down the number of explanations for the gender gap. Since hormonal activity is clearly related to age, one interpretation of the rise and fall of the female/male ratio over the life cycle could be that female sex hormones might contribute to the higher female rates. However, social roles –especially marital and employment status – are also changing over the life cycle, as Mirowsky [15] has pointed out. Therefore only the combined analysis of age and marital and employment status could shed some light on the mechanisms which influence the rise and fall of the gender gap with advancing age.

In a preceding paper analysing first ever in-patient admission rates for depression, we have shown that the generally reported female to male ratio of 2:1 can be higher in specific marital and employment status categories, but also much smaller, that it may disappear or even become reverse [16]. The latter pattern was observed in the employed widowed persons, suggesting that age might be a further intervening variable. While marital and employment status probably exert their effect through psychosocial mechanisms, the interpretation of the impact of age is more complex, since it may influence the risk of depression both by biological and psychosocial mechanisms.

Poor data exist on the combined influence of age, marital or employment status on the female/male ratio of depression. The reason is that most epidemiological studies identify only relatively small absolute numbers of cases and are therefore limited in the number of variables they can study simultaneously. Usually they have to compromise between the breadth of age categories and the number of additional variables studied. The study by Anthony and Petronis [2], while taking many variables into consideration, suffers from a small sample (N = 193) of depressed patients, and conclusions, especially about the interaction of the many variables must remain inconclusive. In contrast, for the present investigation a large (population based) number of first admitted depressed patients (N = 2599) was available which offered the unique opportunity to calculate age specific sex ratios for different marital and employment status categories.

## Methods

Up to mid 1974 all inhabitants of the city of Vienna requiring psychiatric in-patient treatment were admitted to one central hospital, the Department of Psychiatry of the University of Vienna. On January 1 1971, a computerised case record system for in-patients (which is still in operation today) [17] was set up, which allows to register – in addition to demographic data – a number of clinical variables in a structured way. Up to mid 1974, after a thorough diagnostic check-up (applying ICD-8 criteria) and acute treatment, most patients were referred to a large mental hospital after some days. Since admission policy was strictly regulated according to administrative boundaries and since there existed no other facilities for psychiatric in-patient treatment in or near Vienna, this computerised case record system offers the unique opportunity to analyse a large representative population of in-patient admissions. In the second half of 1974, in-patient admissions were no longer centralised at the Department of Psychiatry. Therefore, our analysis covers the 42 months between 1st January 1971 and 30th June 1974.

Only patients fulfilling ICD-8 diagnostic criteria for 300.4 (neurotic depression) or 296.0/296.2 (involuntary melancholia, manic-depressive psychosis-depressed type) and having been admitted for the first time ever to the Department of Psychiatry were included in the present analysis. In ICD-8 the term "manic-depressive" was used for both unipolar and bipolar affective disorders, but ICD 296.2 exclusively refers to unipolar depression. (ICD-8 criteria for depression are largely similar to ICD-9 criteria which are still in use today in Austria). The population census of 1971 (1,614,841 inhabitants) allowed to calculate age and sex specific rates for first ever admissions per 100.000 of the Viennese population for single age intervals. The age range studied was confined to the five decades between 18 and 67 years, since absolute numbers

were small below and above these limits. Thus, our study does not relate to the very old. Marital and employment status for admitted patients were recorded in the same way as in the population census. It was therefore possible to calculate age and sex specific population based depression rates also for these two variables. For the present analysis "employed" covers both, full-time and part-time employment; "not employed" is a residual category including those currently not on a payroll, i.e. unemployed, but also students, houseworkers and retired persons.

The large number of patients even allowed the use of single year age intervals for representing the results as graphs for age specific female and male rates as well as for the female/male sex ratios.

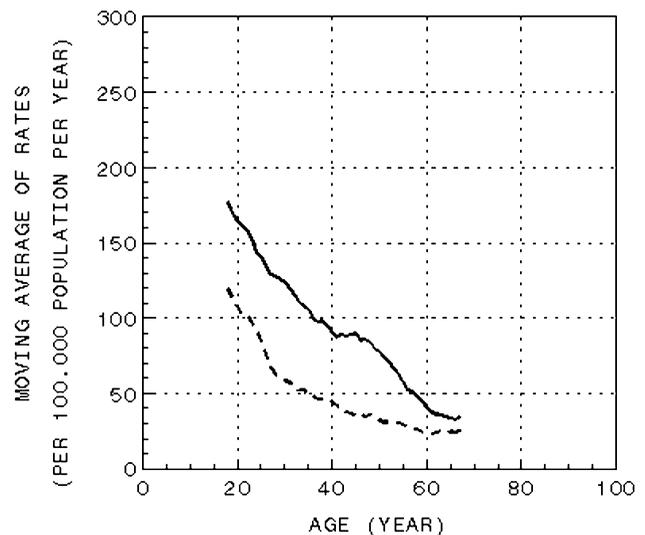
For this purpose the method of "moving averages" with interpolated corrections for marginal values in the age distribution was employed. The moving average was calculated by averaging two points on either side of a target value. Thus, the length of the moving average was five. This smoothing technique minimises the effect of irregular or random variations. 95 % confidence limits are also shown in the graphs, in order to be able to observe deviations from the null hypothesis of no differences between the female and the male rates (i.e. from a ratio of 1). Conclusions are drawn from inspecting the course of the specific curves and the confidence limits over the life time and from employing one-tailed t-tests for comparisons between the age groups of 18–34 ("young") and of 35–51 ("middle aged") (increase of the female/male ratio?) and of 35–51 ("middle aged") and 52–67 ("old") (decline of the female/male ratio?).

## Results

### Sex and age

While the overall annual incidence rate of first ever admission for depression was 49.0 per 100.000 men and 86.5 per 100.000 women (69.6/100.000 for the combined group), age specific rates varied to a substantial degree (Figure 1). Among the 1773 depressed women and 826 depressed men the highest incidence rates were found in the youngest age-groups, with a steady decline in male rates with advancing age which was levelling off after the age of 60 at a low value. The female curve started from a higher level (around 180/100.000 at age 18) than the male rate (around 120/100.000), both female and male rates declined rather sharply, but the female rates levelled off between 40 and 50 and dropped sharply thereafter to as nearly a low rate as the male rate at age 65 (around 30/100.000).

Age-specific female/male ratios started at around 1.5:1 at the age of 18, rose more or less steadily to a peak of 3:1 at the age of 45, and fell more steeply thereafter again to a value of around 1.5:1 at the age of 67 (Figure 2). As can be



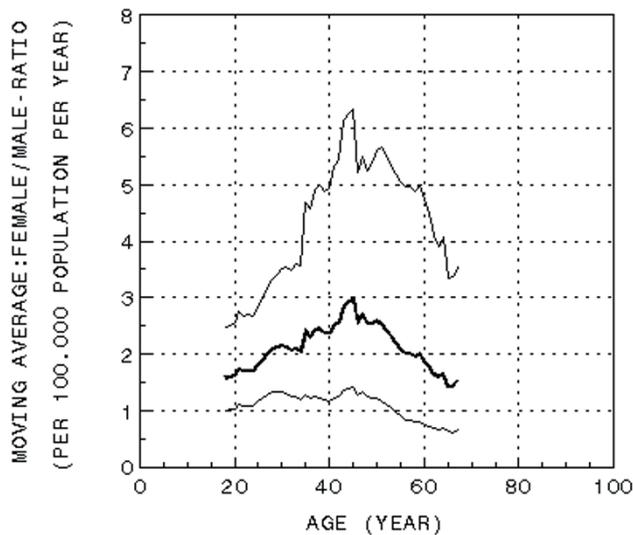
**Figure 1**  
Age-specific incidence rate of depression in first admitted women and men (total number) – female (N: 1773), --- male (N: 826)

deducted from Figure 1, the mid-life peak resulted from the levelling off of female rates during the mid-life period, while male rates declined more steadily. Our curve showed a remarkable similarity to the inverted U-shape curve described by Jorm [1]. The 95 % confidence limits suggest a significant deviation of the female/male ratio from a 1:1 ratio during midlife. Correspondingly the comparison of means sex ratios between the "young" (18–34yrs.) and the "middle-aged" (35–51yrs.) showed a significant increase ( $p < .05$ ), followed by a significant decrease ( $p < .05$ ) between the "middle aged" and the "old" (52–67yrs.).

### Marital status, sex and age

With few exceptions, married persons had lower rates than not married persons. These exceptions included very young men (up to the age of 25) and women beyond the age of 50 years where no or only minor marital status differences were found.

Up to the age of 25 married men and married women had similar rates (around 100/100.000). However, married men showed an extremely steep decline within a few years thereafter (Figure 3). From age 30 onwards, male rates decreased very slowly and became stable at the age of 60 at a low level (around 25/100.000). Rates of married women also showed a decline after 25, but this decline was less steeper until the age of 50 (around 80/100.000), followed by a steep decline leading to identical low male and female rates at the age of 67 (around 25/100.000). Thus, while there was a general decline of depression rates with



**Figure 2**  
Female/male ratio of sex specific rates and 95% confidence limits (total number) (light lines show upper and lower CLs)

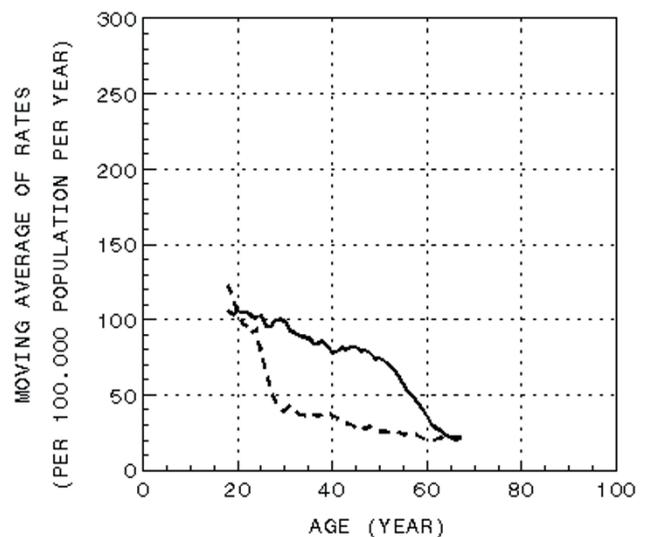
increasing age, this decline occurred very early in husbands but very late in wives, with a resulting large and long-lasting gap in mid-life.

These patterns had a profound influence on the age specific female/male ratios. At the age of 18 the usual female/male ratio was slightly below one, but climbed immediately to 3:1 at age 30 and stayed slightly below or even above this value until the age of 50; thereafter it declined steeply to a value of 1 at age 67 (Figure 4). Thus, for married persons again an inverted U-pattern was found (as far the total population), but due to it's earlier occurrence, the peak was much broader than in the total group. The 95 % confidence intervals showed a clear departure of the 1:1 ratio already at age 25 and a return to it at age 55. The increase between the "young" and the "middle aged" group (35–51 yrs.), however, was not statistically significant (probably due to the too broadly defined young adult age group of 18–34), but the decline after midlife was statistically significant ( $p < .05$ ).

In Figure 5 the curves just described for married men and women are shown for all categories of not married persons combined, i.e. for the total group of those never married, widowed or divorced. Rates were substantially higher than in the married, but this was more pronounced among the "young" and the "middle-aged" than among the "old". The patterns were completely different than those observed for married men and women. Not married women had very high rates (around 200/100.000) up to their mid-thirties with a steady and rather steep decline thereafter to values around 500/100.00 after age 60. Not

married men started out with half the ratio (100/100.000) of not married women, showed a decline with advancing age and became identical with the rates of not married women after the age of 55. Around the age of 20 the rates for "not married" men were roughly the same as those for married men and for married women (around 100/100.000), but showed a much smoother decline with advancing age than that for husbands; thus, after the age of 25 not-married men had substantially higher depression rates than married men. In contrast, in early adulthood not-married women had substantially higher rates than wives, but their rates dropped continuously and became practical identical with the rates for not-married women (and also not married men) after the age of 55 and thereafter. It can be concluded that marital status seemed to matter only in the "young" and in the "middle-aged", but not in the "old". It was not possible to calculate age and sex specific rates separately for the "not married" subcategories, i.e. the divorced and the widowed, because numbers became too small. Only the "never married" group was large enough to calculate these rates. Analyses show that the pattern for the never married is largely similar to that found for the total group.

The age distribution of the female/male-ratio of the not married was completely different from that found in the overall population and for married persons (Figure 6). It was already around 2:1 at the age of 18 and rose slowly to above 2.5:1 in mid-life and declines to 1 at around 55 and remained stable thereafter. The increase of the sex ratio to-



**Figure 3**  
Age-specific rates of depression in first admitted married women and men – female (N: 925), --- male (N: 378)

wards midlife was statistically not significant, but the decline thereafter was ( $p < .05$ ).

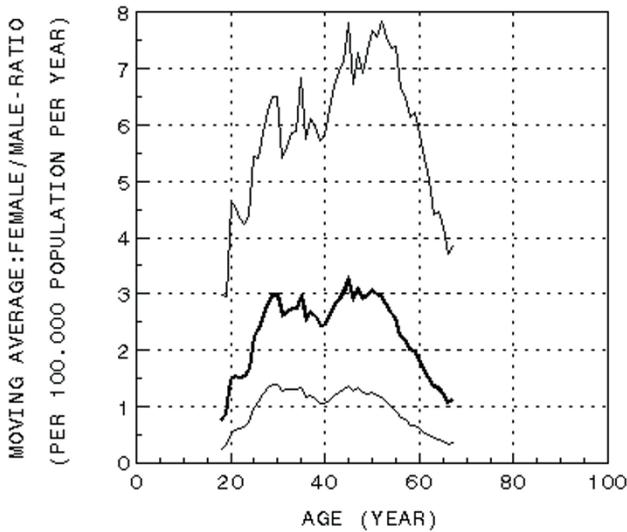
It can be concluded so far, that, if marital status is considered, the inverted U-shape of the age specific sex ratio found in the total population was more pronounced among married persons and much less so or nearly non-existent among not married persons.

**Discussion**

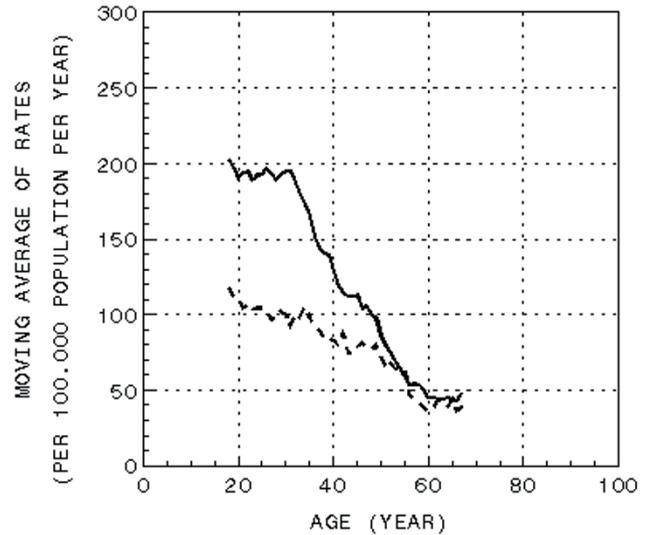
The findings of our detailed analysis are not easy to interpret, first of all, because other variables changing over the life cycle (like hormonal status, child care, social conditions) were not assessed. The fourfold interaction between sex, age, marital and employment status could not be analysed neither, because numbers would have become too small. Finally, marital status and employment status may act as factors influencing referral. Concerning the latter problem, it has to be stressed though, that we exclusively analysed first ever admissions from a strictly defined catchment area and that at the time period for which data were collected the psychiatric out-patient care system was underdeveloped in Vienna. If nothing else, our data can show what might happen to the sex ratios of incidence rates if marital and employment status were considered together with age.

**Employment status, sex and age**

In general, rates for the not employed were higher than those for the employed at all ages, and this applied to both men and women. But there were clear sex differenc-



**Figure 4**  
Female/male ratio of sex specific rates and 95% confidence limits in married women and men (light lines show upper and lower CLs)



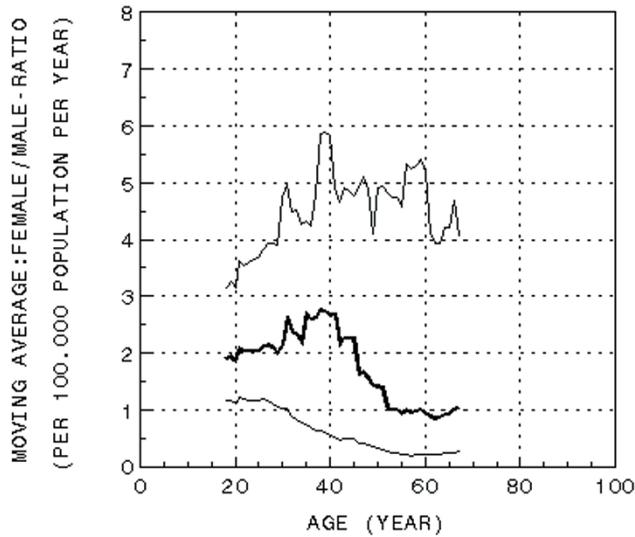
**Figure 5**  
Age-specific rates of depression in first admitted not married women and men – female (N: 848), --- male (N: 448)

es. Among the employed, female rates were consistently higher than male rates. For both employed women and men, a steady decline in depression rates over the life cycle with a narrowing down of the gender gap (Figure 7) was observed and rates were becoming nearly identical at age 60 at a low level (around 30).

The nearly parallel decline resulted in a female/male ratio which was more or less the same from age 18 to age 50 (just below 2:1), while it dropped sharply after 50 and had a value of around 1 after the age of 60 (Figure 8). In contrast to the midlife rates (35–51) the decline after 50 was statistically significant ( $p < .05$ ). Thus, in the employed, while still being around 2:1, the sex ratio curve was flattened up to the age of 50 if compared to the total population (Fig. 2). After 50, however, it dropped in the same way as in the analyses described so far.

The rates for the not employed showed a completely different pattern from those described so far. (Figure 9). While rates were in general very high (around 200/100.000 at age 18 and still around 150 at age 50) men had a pronounced peak in midlife (30–40) with depression rates climbing up to over 250 per 100.000 per year, which was 6 times higher than that found in employed men of the same age group (Figure 7). After the age of 50, male and female rates were astonishingly similar among the not-employed and fell sharply to between 30 and 50/100.000 after the age of sixty.

The female/male ratios among the not employed did not deviate much from 1. Because of the male peak in mid-life



**Figure 6**  
Female/male ratio of sex specific rates and 95% confidence in not married women and men (light lines show upper and lower CLs)

the female/male ratio for the not-employed became negative during this period (Figure 10). Before and after this midlife "deviation", the female/male ratio was only slightly above 1. The fall from young adulthood to midlife and the rise again from midlife to late adulthood were both statistically significant ( $p < .05$ ).

With these caveats in mind, we can first confirm the finding by Jorm [1] of an inverted U-shape of the female/male ratios of depression rates over the life cycle. While being around 1.5:1 both in young adulthood and around the age of 60, the female/male ratio increased towards midlife, with a peak at 45 to 50 and declined thereafter. Thus, our data confirmed the results of other studies quoted in the introduction of the present paper [4-6,9], showing that depression in women becomes less frequent after the menopause. Eaton et al. [18] in an incidence study starting from ECA data also found an inverted U-shape for female depression rates.

The two interpretations which come immediately to one's mind are biological on the one hand (female rates are increasing during the hormonally active period of women and decrease thereafter) and psychosocial on the other hand (life stress is increasing for women with middle age and decreases thereafter), which might mutually influence each other. No decision, however, is possible between these interpretations without considering other variables.

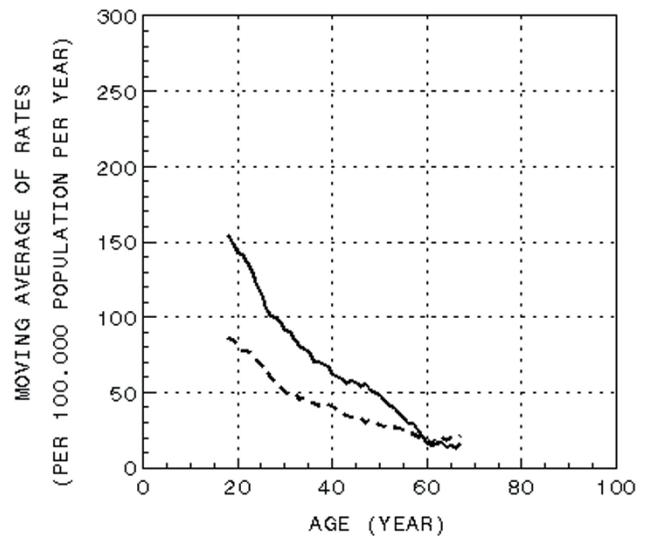
When analysing the additional influence of marital status it becomes clear that it was marriage which largely ac-

counted for the inverted U-shaped curve. In married persons the female/male ratios climbed early (at around 30) to the 3:1 level, stayed there until the age of fifty and declined sharply thereafter. In other words: among the married the inverted U was broad, while in the total population it was rather a V than an U.

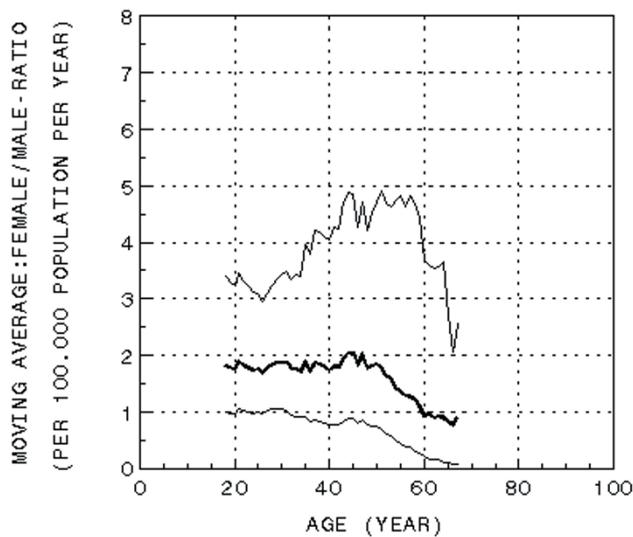
Thus, while among the married, rates were usually lower than among the not married, the gender gap was larger at a much earlier age than in the total population. This favours a psychosocial interpretation (marriage being more stressful for women than for men), but still, a biological interpretation is not ruled out, since married women may rather have children -and child bearing is related to hormonal changes (there was no possibility in our analyses to find out how frequently post-partum depression occurred).

Among the not married (taken as a group, including the never married, the divorced and the widowed) the inverted U-shape curve was found only in a rudimentary form, with a decline after the age of 40 (from around 2.8:1 to 1:1 at the age of 50 and later). It is difficult to interpret this curve, also if considering that the subgroup of the never married corresponded to the total group of the not married (for divorced and widowed persons the analysis could not be carried out due to the small numbers of cases in these subgroups if divided into single age groups.)

Employment status also changed the general pattern of an inverted U-shape found for the total population to a substantial degree. Among the employed the female/male ra-



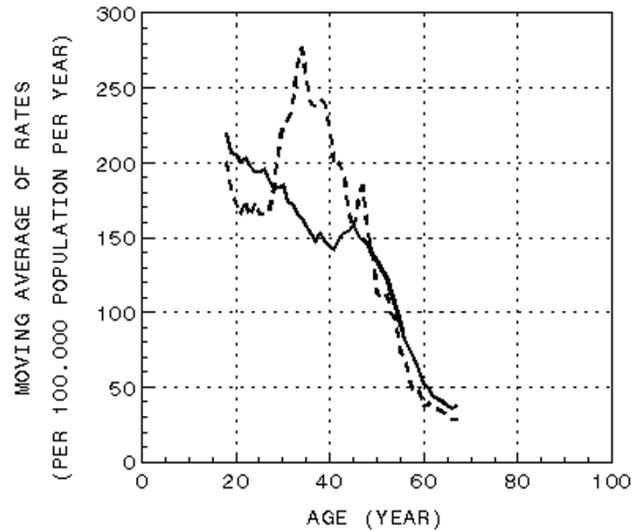
**Figure 7**  
Age-specific rates of depression in first admitted employed women and men – female (N: 785), --- male (N: 587)



**Figure 8**  
Female/male ratio of sex specific rates and 95% confidence limits in employed women and men (light lines show upper and lower CLs)

ratio was constant (below 2:1) from the age of 18 to 50, and dropped thereafter to 1:1. The inverted U-shape virtually disappeared in this analysis. It seems that up to the age of fifty the raised risk for employed women was not age-dependent on age; the female preponderance tended to disappear beyond the age of 50. The not employed showed a pattern which was the opposite to that observed in the total population – there is a U-curve – but not an inverted one, but an upright U, i.e. in midlife not employed men had a clearly higher risk than not employed women.

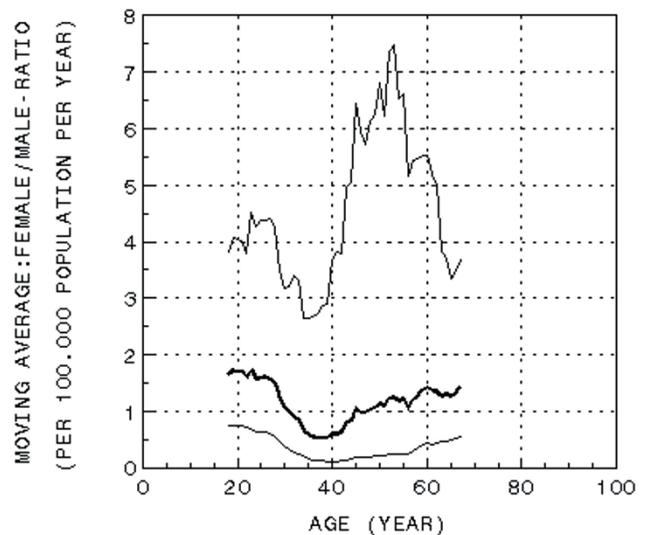
The employment findings clearly favour a psychosocial explanation of the variations of the female/male depression rates over the life cycle as opposed to a biological one. If men were not employed in midlife, the risk of being admitted for a first ever depression episode was much higher than that for women. Data support the hypothesis that unemployment increases the risk for psychological disturbances- especially for affective disorders – in both men and women [2,19–22]. The reverse sex ratio found in the not employed group of our investigation may reflect differences in the demands and social role expectations connected to the specific social roles of men and women. Unemployment may undermine men's ability to fulfil their role obligations. For married men unemployment has additional implications for their family status and relationships. In this context, it has to be stressed that women's and men's labour market position and role in the family have undergone substantial changes since the 1970s and the impact of psychosocial mechanisms on



**Figure 9**  
Age-specific rates of depression in first admitted not employed women and men – female (N: 988), --- male (N: 239)

both women and men might have changed during the last decades.

Our analyses show, that the female/male ratio in first ever admitted depressed patients was age dependent and that there is a complicated interaction with marital and employment status. As the presented data are cross-sectional,



**Figure 10**  
Female/male ratio of sex specific rates and 95% confidence limits in not employed women and men (light lines show upper and lower CLs)

the age group differences could as well rather reflect cohort than ageing effects. While we cannot be sure whether these findings are relevant for the aetiology of depression or only reflect referral peculiarities, they suggest that incidence studies should be carried out in unselected community populations considering sex, age marital and employment status simultaneously. Only in doing so we can narrow down the number of possible psychosocial and biological explanations of the gender gap in depression.

### Competing interests

None declared

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