Decomposition of Disability Prevalences. Age and Rate Effects in Northern Sweden, 1900–1950

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Decomposition of Disability Prevalences

Age and Rate Effects in Northern Sweden, 1900–1950

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ABSTRACT

This study examines changes in disability prevalence during Sweden's demographic transition, focusing on the relative contributions of population aging and changing disability rates. Using unique longitudinal data from parish registers covering 194,500 individuals in Västerbotten county 1900–1950, we analyze trends in four disability categories: sensory, physical, mental and intellectual disabilities. Through demographic decomposition methods, we separate the effects of changes in population age structure from changes in age-specific disability rates. Our findings reveal that the substantial increase in disability prevalence was primarily driven by changes in disability rates during the period studied rather than population aging. Mental disabilities showed the most pronounced increase, rising from 0.8% to 2.5%, while other disability types remained stable or declined. The impact was particularly strong among middle-aged adults (25–54 years), challenging assumptions about the predominant role of population aging in historical disability trends. Our results suggest that social and environmental factors played a more significant role than demographic change in shaping disability prevalence during times of demographic transition.

Keywords: Disability, History of health, Historical population data, Sweden

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1 INTRODUCTION

The global prevalence of disabilities has increased significantly in recent decades, driven by population aging and changes in health conditions (WHO, 2022). Population aging is expected to accelerate this trend, as disability risks typically increase with age. Recent projections suggest that by 2050, more than two billion people will be aged 60 or older, compared to about one billion today (UN, 2022). This demographic shift will have profound implications for disability prevalence, healthcare systems, and social support structures.

Moving back to the 1900–1950 period, our study aims to provide historical knowledge on the dynamic relationship between population aging and disability prevalences. This relationship is complex, as longer life expectancy might lead to extended periods of disability in late life — or expansion of morbidity (Gruenberg, 1977) — while improvements in health and living conditions could also compress disability into a shorter period before death (Fries, 1980). Recent research shows varying patterns across countries and time periods, with some evidence of both compression and expansion depending on the context and type of disability (Chatterji et al., 2015; Crimmins & Beltrán-Sánchez, 2011). Historical knowledge about the relationship between population aging and disability is crucial for several reasons. First, it helps anticipate future trends as populations continue to age globally. Second, it provides insights into how social and medical progress might modify the age-disability relationship. Third, it informs policies aimed at healthy aging and disability prevention (Freedman et al., 2016; Tao et al., 2020).

The first half of the 20th century represents a key period for understanding the relationship we focus on. This era witnessed the beginning of population aging in many Western countries, with a shift from predominantly young populations toward higher proportions of middle-aged and older adults. This transformation, which we refer to as population aging, was driven by declining fertility rates and improving survival at older ages (Reher, 2004). Simultaneously, improvements in public health and medical care were transforming patterns of morbidity and mortality (Omran, 1971; Riley, 2001). Sweden's exceptional historical records and early demographic transition provide an ideal context for examining how these fundamental changes affected disability prevalences in the population.

Research on disability trends has been examined through various methodological approaches, though often constrained by data limitations. Historical studies typically rely on cross-sectional censuses or institutional records (Cohen, 2001; Hudson, 2005; Jarvis, 1855), which capture point-in-time snapshots but struggle to reveal dynamic patterns over extended periods. Contemporary disability research has increasingly employed decomposition techniques to separate the effects of multiple contributing factors. For instance, Hosseinpoor et al. (2012) and Tetteh et al. (2021) used Blinder-Oaxaca decomposition to quantify how much of gender disparities in disability prevalence could be attributed to demographic characteristics (such as age) versus differential effects of these characteristics. Similar approaches have been applied to examine socioeconomic inequalities in disability (Kim & Jeon, 2023) and geographic variations in disability program participation (Gettens et al., 2018). While these methods have enhanced our understanding of contemporary disability patterns, they have rarely been applied to historical data spanning major demographic transitions. This analytical gap between historical documentation and modern statistical techniques limits our understanding of how population aging and changing disability risks have interacted over time during periods of substantial demographic and epidemiological change, such as those experienced in early 20th century Sweden.

Our study covers some of this gap in knowledge by utilizing unique longitudinal data on Swedish populations in 1900–1950. This data provides comparatively detailed information about individuals' disability status, allowing us to analyze how disability prevalence evolved during a crucial period of demographic and epidemiological transition. We focus particularly on whether changes in disability prevalence were primarily driven by population aging or by shifts in age-specific disability risks.

Specifically, we address four research questions:

1. How did prevalence of different disability types and the age structure change in Sweden in the period 1900–1950?
2. To what extent were changes in disability prevalence driven by population aging versus changes in age-specific disability rates?
3. How did the relative contributions of population aging and disability rate changes vary over time throughout the study period?
4. Which age groups contributed most significantly to changes in disability prevalence, and did these patterns differ across disability types?

2 METHODS

Our study leverages longitudinal data from Swedish parish registers 1900–1950. This enables us to examine changes in disability prevalence during a period of significant demographic and epidemiological transition. We develop a multi-faceted analytical approach to disentangle the drivers of changing disability patterns. Drawing on Kitagawa's (1955) decomposition method, we separate changes in disability prevalence into components attributable to population aging versus changes in age-specific disability rates. Originally developed for analyzing mortality differentials, we adapt this approach to quantify the relative contributions of age structure and disability risk to changing prevalence over time. Our approach differs from cross-sectional decomposition methods used in recent disability research (Gettens et al., 2018; Hosseinpoor et al., 2012) by focusing on temporal changes rather than group differences, allowing us to track how these components evolved throughout Sweden's demographic transition.

2.1 DATA

Our data is drawn from parish registers in the Poplink database, Umeå University (2023), and covers all populations in 10 parishes across Västerbotten county, Sweden, 1900–1950. In total, the data comprises 194,500 individuals aged 15–100 years, including 4,700 with recorded disabilities. As there is not only information about when the disability was recorded but the type of it as well, we can distinguish between sensory (visual and auditory impairments), physical (bodily defects, mobility impairments), intellectual (cognitive dysfunctions from birth/childhood, e.g. 'idiocy', 'feeble-mindedness') and mental disabilities (psychiatric illnesses acquired across life, e.g. 'insanity', 'psychosis'). In these historical records, disabilities were documented when a person's sensory, physical, mental, or intellectual conditions impeded their capacity to participate fully in community life, especially their ability to maintain employment and economic independence. This conceptualization aligns with aspects of contemporary frameworks such as the WHO's, which emphasize the interaction between individual conditions and social contexts (WHO, 2022). We recognize that disability categories evolved throughout this period, reflecting changing social perceptions and institutional practices. The complex processes of disability recognition, registration practices, and individuals who receive such recognition are analyzed in detail by Wisselgren and Vikström (2023), who thoroughly examine the instructions for Swedish disability registration practices 1860–1930.

2.2 ANALYTICAL STRATEGY AND MEASURES

We employ four complementary analyses to understand the temporal dynamics of disability prevalence. First, we calculate annual prevalence rates for each disability type to establish basic temporal trends. Following standard demographic practice, we compute these rates as the number of individuals with disabilities divided by the total population at risk, expressed as percentages. To examine changes in population age structure, we calculated the percentage of the population in each age group (15–24, 25–34, ..., 75+) in 1900 and 1950, allowing us to visualize demographic aging during the study period.

Second, we implement a decomposition analysis to which changes in disability prevalence were driven by population aging versus changes in age-specific disability rates, following Kitagawa's (1955) method for rate decomposition. This approach allows us to separate changes in disability prevalence between 1900 and 1950 into two distinct components: those due to changes in population age structure and those due to changes in age-specific disability rates. Following Kitagawa's method, we express the change in disability prevalence (ΔP) between 1900 (t1) and 1950 (t + n, n = 50) as the sum of an age structure component (A) and a rate component (R):

$$\Delta P = A + R$$

The age structure component (A) measures how changes in the population's age distribution affected overall prevalence:

$$A = \sum \Delta w(\mathrm{x}) * \frac{c(x,t) + c(x,t+n)}{2}$$

where $\Delta w(x)$ represents the change in the proportion of the population at age x, weighted by the average disability rate at that age across between 1900 (time t) and 1950 ($x + n$,n = 50). This component captures the effect of demographic shifts, such as population aging, while holding disability rates constant. The rate component (R) measures how changes in age-specific disability rates affected overall prevalence:

$$R = \sum \Delta c(\mathrm{x}) * \frac{w(x,t) + w(x,t+n)}{2}$$

where $\Delta c(x)$ represents the change in the disability rate at age x across the two time points, weighted by the average population proportion at that age. This component captures changes in disability risks while adjusting for demographic composition.

We calculated these components for each disability type (mental, sensory, physical, and intellectual). This allows us to assess whether the relative importance of demographic versus rate effects varies across different types of disabilities. Then, we quantified the percentage contribution of each component to the total change in prevalence, providing a clear measure of their relative importance.

Third, we implement a temporal decomposition using five-year moving windows (n = 5) throughout the study period. This approach applies the same decomposition to successive years to track how the absolute magnitude and direction of demographic change versus disability risk evolved over time. This temporal analysis helps identify whether the drivers of disability prevalence remained stable or shifted during different phases of Sweden's demographic transition, and whether these patterns varied across disability types.

Fourth, we extend this decomposition to examine age-specific contributions to overall change 1900–1950, adapting Preston et al.'s (2001) methodological framework originally developed for demographic analysis. While the standard Kitagawa decomposition provides aggregate measures of age structure and rate effects, Preston's approach emphasizes that changes in population-level indicators are differentially driven by specific age groups, each with potentially distinct underlying mechanisms. Following this principle, instead of immediately summing across all ages, we maintained separate decomposition components for each age group (g) (15–24, 25–34, ..., 75+). This allowed us to identify which life stages contributed most significantly to changing disability patterns. The same equations apply, but with age groups (g) rather than individual ages (x). Importantly, these age-specific components sum up the total change in disability prevalence, allowing us to express each age group's contribution as a percentage of the total change.

This age-specific approach provides several analytical advantages over the aggregate decomposition. It identifies which age groups were the primary drivers of change, revealing whether disability trends were concentrated in particular life stages. The approach allows us to observe whether age structure and rate effects operated uniformly across age groups or exhibited different patterns at different ages. Additionally, it enables comparisons across disability types regarding which age groups contributed most to changing prevalence.

3 RESULTS

First, our analysis reveals distinct patterns in both population age structure and disability prevalence during the study period 1900–1950. Figure 1 shows the changes in age distribution of the Swedish population (age 15+) between 1900 and 1950. A clear demographic shift is evident, with a substantial decrease in the proportion of younger individuals and a corresponding increase in middle and older age groups. The proportion of the population aged 15–24 decreased markedly from 30% in 1900 to about 21.8% in 1950. Meanwhile, all age groups from 25 years and older show higher proportions in 1950 compared to 1900, indicating population aging during this period. This shift is particularly noticeable in the middle age ranges (25–64), where each group shows between 1.5–2.5 percentage points increase.

Figure 2 shows that mental disabilities exhibited the most pronounced increase, from approximately 0.8% in 1900 to 2.5% by 1950. This increase was particularly steep after 1910. In contrast, the prevalence of other disability types remained relatively stable or showed modest changes. While intellectual disabilities slightly increased from 0.5% to 0.7%, physical disabilities maintained a relatively constant prevalence around 0.2–0.3%. Notably, sensory disabilities declined gradually over time, from 0.7% to 0.4%.

Figure 1 *Age distribution in the study population 1900 and 1950*

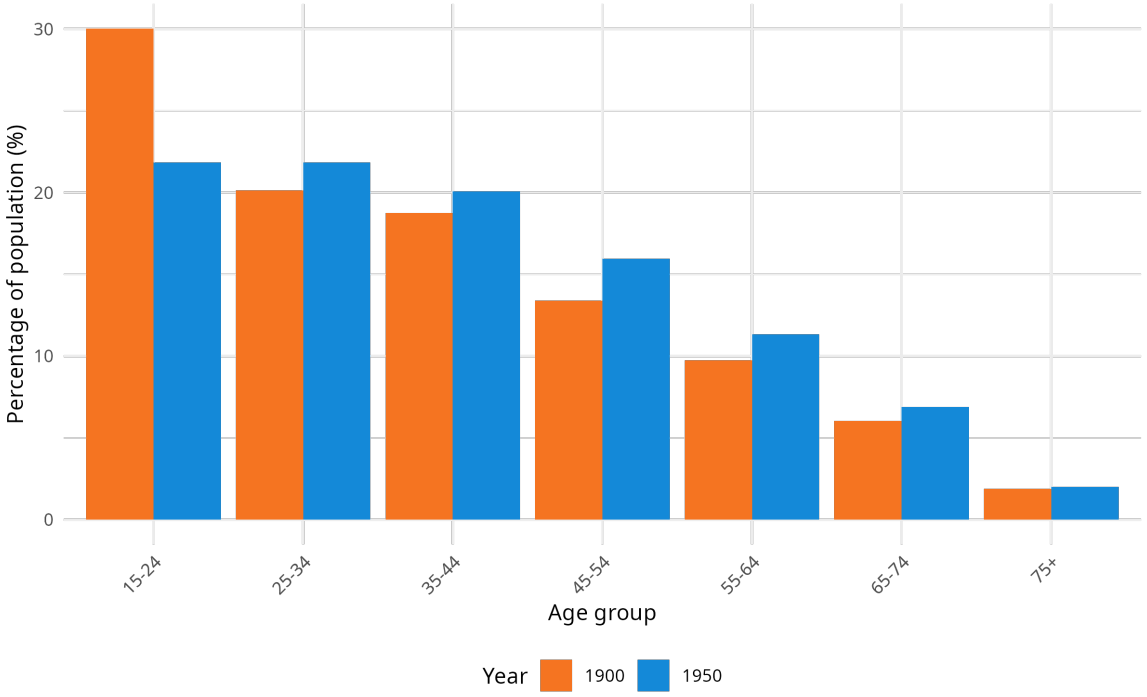
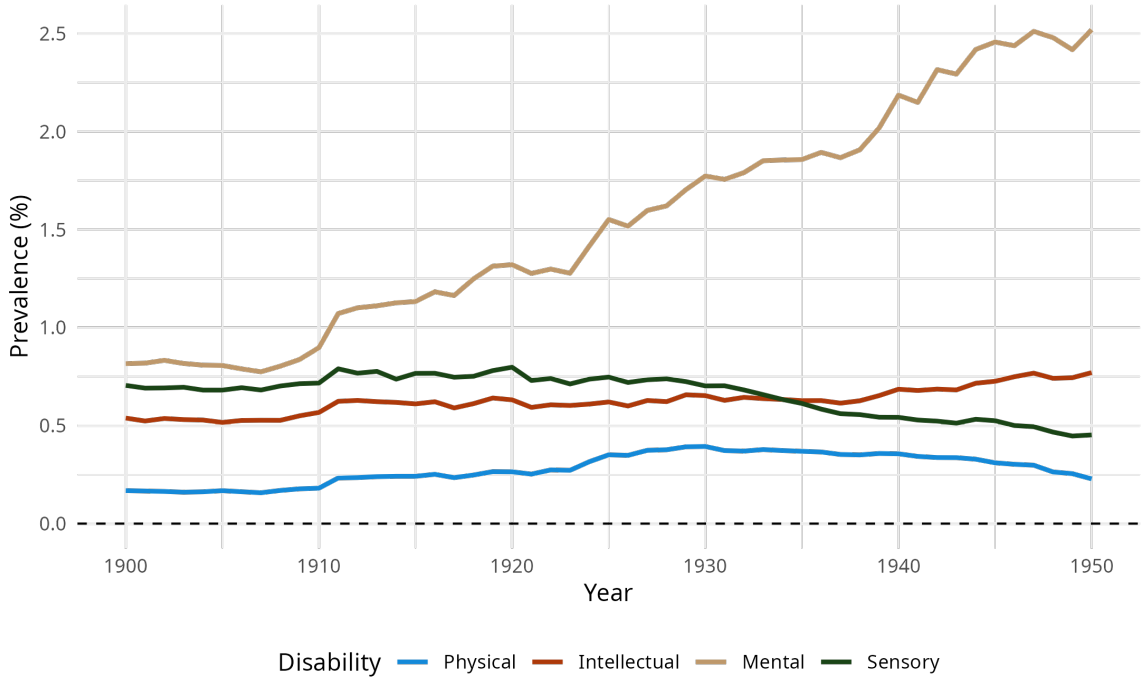


Figure 2 *Trends in prevalence by disability type in the Swedish population studied 1900–1950*



Second, our decomposition analysis reveals that the change in prevalence 1900–1950 was primarily driven by changes in disability rates rather than changes in age structure. Specifically, 91% of the total change was attributable to rate effects, while changes in age structure contributed only 9%. This pattern varied considerably across disability types (Figure 3). Mental disabilities showed the largest increase in prevalence (1.7 percentage points), with rate effects accounting for 92.8% of this change and age structure effects for 7.2%. This suggests that the rise in mental disability prevalence was predominantly due to increased rates within age groups rather than demographic aging.

Physical disabilities experienced a smaller increase (0.06 percentage points), with rate effects again dominating but to a lesser extent: 78.2% of the change was due to rate effects and 21.8% to age structure. For intellectual disabilities, which increased by 0.25 percentage points, the rate effect was even more dominant, accounting for 104% of the change, while age structure had a small negative effect (-3.5%).

Notably, sensory disabilities showed a different pattern, with prevalence decreasing by 0.24 percentage points over the period. This decline was more than fully explained by rate effects (-111% of the change), while age structure changes worked in the opposite direction, contributing to a small increase (11.4% of the total change).

Third, the temporal decomposition analysis (Figure 4) demonstrates that the magnitude and direction of rate and age structure effects varied over time. Mental disabilities show consistently positive rate effects throughout the period, with particularly strong effects during the 1910s and 1940s. The age structure effect for mental disabilities, while positive after approximately 1935, remained relatively small in absolute terms. For other disability types, both rate and age structure effects were smaller in magnitude and varied more across time. Sensory disabilities exhibited predominantly negative rate effects after 1920, while the age structure effect remained slightly positive, reflecting the ongoing aging of the population shown in Figure 1.

Figure 3 *Decomposition of relative contribution to changes in prevalence by disability type in the Swedish population studied 1900–1950*

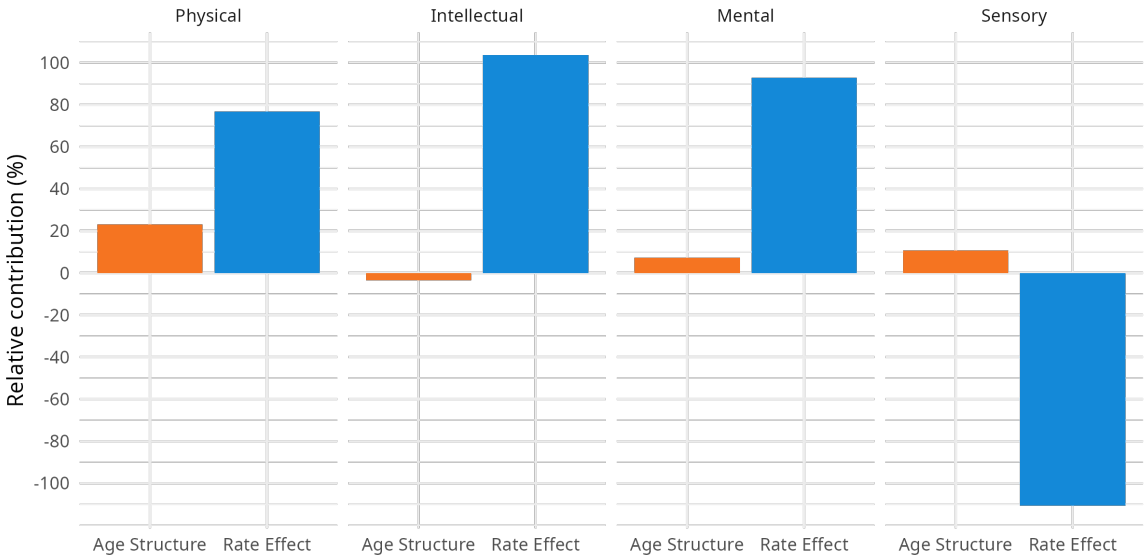


Figure 4 *Temporal patterns (five-year moving window analysis) in the decomposition of prevalence by disability type in the Swedish population studied 1900–1950*

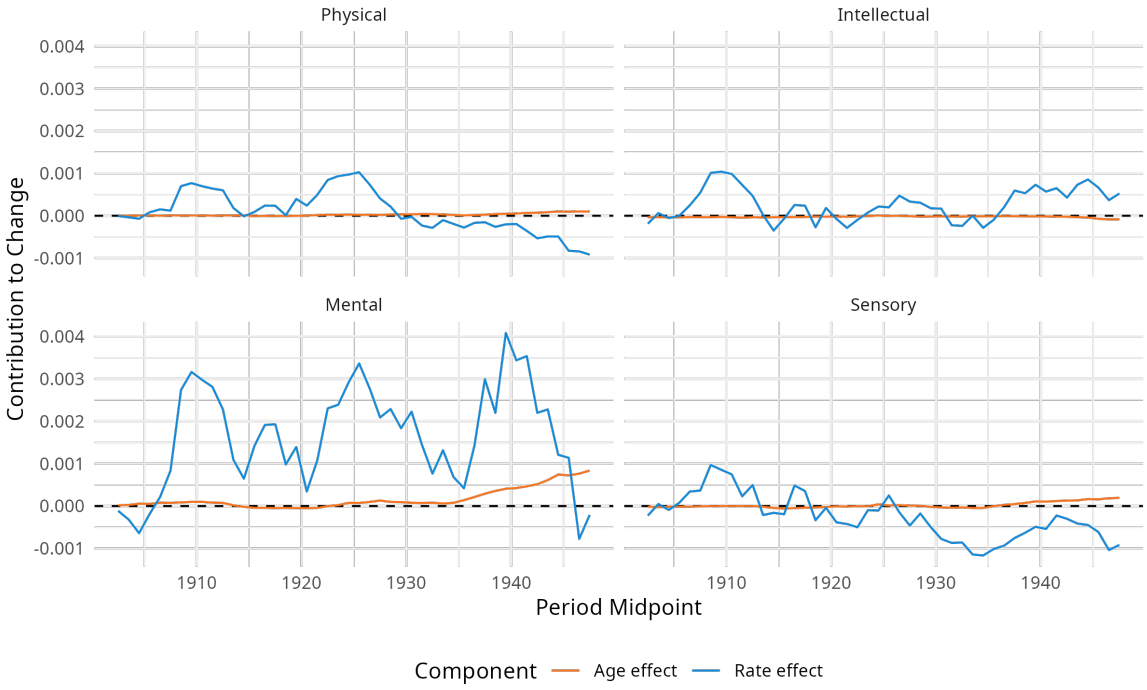
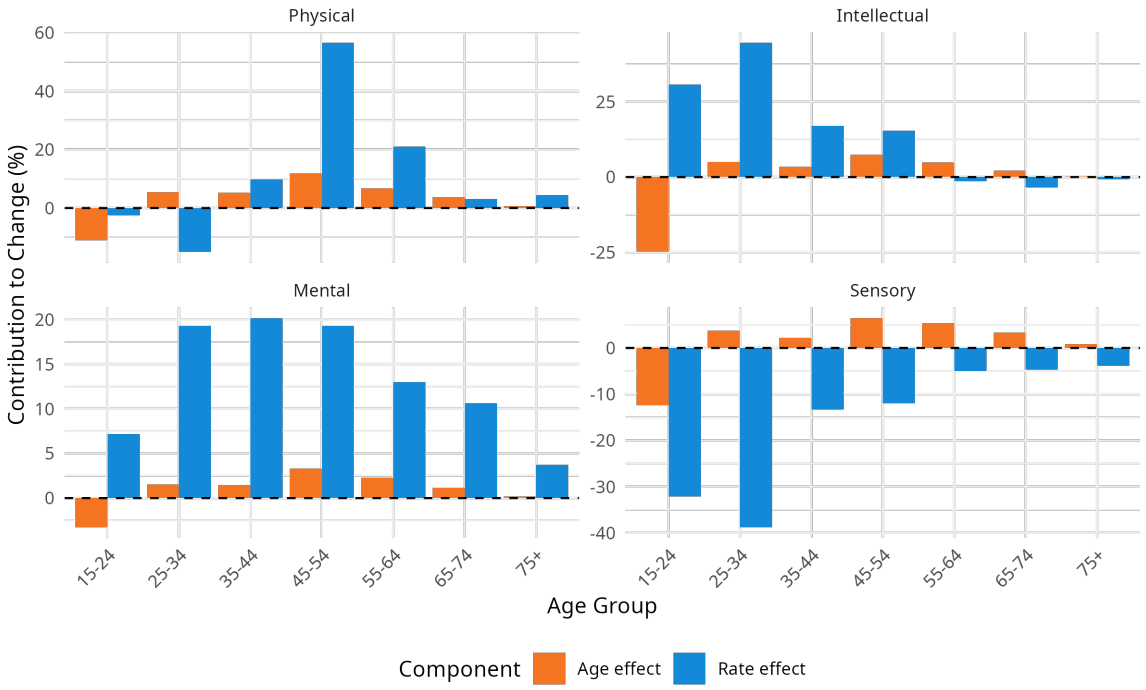


Figure 5 *Decomposition of changes in prevalence by disability type and age group (age structure vs. rate effects) in the Swedish population studied 1900–1950*



Fourth, the age-group specific decomposition (Figure 5) reveals that changes in disability rates, rather than age structure changes, were the primary drivers of prevalence trends. For mental disabilities, positive rate effects were observed across all age groups, with the largest contributions in the middle age ranges (25–54 years). The age structure effect was comparatively small and mostly positive, reflecting the aging of the population. Sensory disabilities showed negative rate effects, particularly pronounced in younger age groups (15–34 years), partially offset by positive age structure effects in older age groups.

4 DISCUSSION

Our analysis of disability patterns in northern Sweden during the first half of the 20th century contributes to ongoing debates about the relationship between population aging and disability prevalence. While contemporary research often emphasizes population aging as a key driver of increasing disability rates (Freedman et al., 2016; WHO, 2022), our decomposition analysis reveals a strikingly different pattern: changes in disability prevalence during this period were overwhelmingly driven by shifts in age-specific disability rates (91%) rather than by changes in population age structure (9%).

These findings challenge conventional assumptions about the primacy of demographic aging in driving disability trends. For mental disabilities, which showed the most dramatic increase in prevalence (from 0.8% to 2.5%), rate effects accounted for 92.8% of this change while age structure effects contributed only 7.2%. Similarly, for intellectual disabilities, rate effects explained 104% of the observed increase, with age structure having a small negative effect (-3.5%). Even for physical disabilities, with their modest increase, rate effects dominated at 78.2%. Only for sensory disabilities, which declined in prevalence, did the age structure component work against the overall trend, contributing a small positive effect (11.4%) that partially offset the strong negative rate effect (-111%).

Our temporal decomposition further illuminates this relationship, showing that rate effects for mental disabilities were particularly strong during specific periods — notably around 1910, 1925, and the 1940s — while age structure effects remained relatively small and stable throughout. This temporal pattern aligns with key institutional developments in Sweden: the expansion of the regional hospital in 1907 (Heimer, 1958), the 1920s saw expansion of welfare state institutions (Hirdman, 1989), and the 1934 opening of Umedalen asylum nearly doubled institutional capacity in the region (Eriksson et al.,

2022). The timing suggests that changing institutional frameworks, rather than demographic shifts, drove the observed increases in disability prevalence.

The dominance of rate effects over age structure effects informs theoretical debates about expansion versus compression of morbidity. Gruenberg's (1977) expansion hypothesis and Fries' (1980) compression hypothesis both assume important roles for demographic aging, but our findings suggest that social and institutional factors may be more decisive than demographic change in shaping disability patterns. The threefold increase in mental disability prevalence despite relatively modest population aging could reflect what might be termed "institutional expansion of morbidity" — where the growth of institutional capacity (new facilities, more beds) led to an expansion of disability categories and the inclusion of new groups previously not classified as disabled, effectively creating supply-driven demand for institutional care (Eriksson et al., 2022). However, it is equally plausible that this increase reflects genuine deterioration in population mental health during Sweden's rapid modernization period. The disruption of traditional agricultural life, changing social structures, and new industrial work patterns created unprecedented psychological stresses (Sundin & Willner, 2007). The temporal spikes in mental disability rates around 1910 and 1925 coincide with periods of accelerated industrialization and urbanization in Sweden, lending credence to this interpretation.

The age-specific decomposition further reinforces this interpretation. Changes in mental disability rates were concentrated in middle-aged adults (25–54 years), precisely the age groups growing during this period of demographic transition. However, our decomposition shows that even within these expanding age groups, changes in disability rates — not merely the growth of these population segments — drove increased prevalence. This suggests that as Sweden's population structure shifted toward middle age, these cohorts simultaneously experienced intensified identification and classification of mental conditions.

For sensory disabilities, the declining rates despite population aging suggest differential improvement patterns across disability types during health transitions. The negative rate effect for sensory disabilities likely reflects technological adaptations (improved eyeglasses, early hearing aids) and changing work environments that reduced occupational hazards which previously caused reduced sensory impairments or their functional impacts (Johannisson, 2013). This pattern aligns with research showing that different types of disability can follow divergent trajectories during health transitions, with some impairments decreasing while others persist or increase (Cutler, 2001; Freedman & Martin, 2000). These divergent trends demonstrate that population aging does not uniformly affect all disability types.

The pronounced dominance of rate effects over age structure effects across multiple disability categories suggests broader social processes at work. While Hacking's (1999; 2013) concept of "making up people" through classification systems offers one explanatory framework — where institutions create categories that shape identification and treatment — we must also consider the possibility of genuine epidemiological change in mental health. The social disruption that accompanied Sweden's transformation from an agricultural to an industrial society likely created real psychological strain, given that this period brought radical changes in family structures, community relationships, and daily rhythms, while introducing new economic precariousness (Sundin & Willner, 2007). Similar to contemporary discussions about rising mental health problems amid social media and digital transformation (Blanchard et al., 2023; Marciano et al., 2021), the early 20th century's technological and social changes may have outpaced psychological adaptation. Our temporal analysis shows spikes in disability rate effects that coincide with both institutional developments and periods of rapid social change.

Some limitations should be considered when interpreting our results. The data comes from parish registers, where disability classification depended on ministers' observations and contemporary understanding of disabilities. It is methodologically challenging to empirically separate "actual" changes in disability prevalence from changes in registration practices, particularly because disability itself is partly constituted through classification systems. The substantial expansion of Sweden's welfare state during this period (1900–1950) likely changed the incentives and purposes for disability registration, as new social support systems developed for different categories of disability. The 1918 Poor Relief Act, for example, established new frameworks for categorizing those eligible for assistance (Rauhut, 2002). These institutional developments affected both the identification and documentation of disabilities, particularly mental conditions, which showed the most dramatic increases in our data (Wisselgren & Vikström, 2023). Additionally, our analysis concerns one region of Sweden, and patterns might differ in other areas or countries.

Our study demonstrates that focusing solely on demographic change may fundamentally misinterpret the drivers of disability prevalence. The overwhelming dominance of rate effects over age structure effects suggests that disability prevalence during Sweden's demographic transition emerged through a complex interplay of changing social responses to human variation, institutional development, and potentially genuine deterioration in population mental health amid rapid societal transformation. This parallels contemporary debates about whether increased mental health diagnosis rates reflect improved detection or actual increases in mental distress (Horwitz & Wakefield, 2007). Our findings suggest that policy responses should focus not merely on accommodating aging populations but on understanding how social institutions, labor markets, classification systems, and societal disruptions jointly shape the experience and prevalence of disability.

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