Membership in and Presence of Voluntary Organisations during the Swedish Fertility Transition, 1880-1949

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ABSTRACT

This article investigates the association between, participation in, and exposure to voluntary organisations and marital fertility during the European fertility transition from 1880 to 1949. This is achieved using individual-level longitudinal demographic data from northern Sweden linked with individual-level information on voluntary organisation membership and contextual level information on organisation activity. How living near an organisation influenced fertility is measured using mixed effect Cox regressions. The association to participation for both men and women is tested by matching members to a control group through propensity score matching before estimating differences in risks of another birth using Cox regressions. The results show that being exposed to an organisation was related to lower fertility. Joining a union or a temperance organisation showed even stronger negative associations, but only for male members, while female members showed no significant difference in fertility. The results suggest that reproductive decisions were not simple responses by the individual couple to structural changes but were also shaped within the social networks of which they were a part.

Keywords: Fertility transition, Sweden, Social networks, Voluntary associations, Voluntary organisations

1 INTRODUCTION

At the same time as fertility declined in Europe from the late 19th century until the 1930s, social movements such as voluntary organisations grew in numbers (Tilly, 2004). For instance, in Sweden they came to encompass around a third of the adult population in the 1930s (Lundkvist, 1980). A number of studies have emphasised the role that social networks, such as social movements, play in shaping, legitimising and changing social norms about family and fertility limitation during fertility transitions (Behrman, Kohler, & Watkins, 2002; Bongaarts & Watkins, 1996; Garrett, Reid, Schürer, & Szreter, 2001; Szreter, 1996; Watkins, 1990; Watkins & Danzi,1995). On an aggregate level, voluntary organisation activity was associated with fertility limitation during the European demographic transition (Junkka, 2018; Larsson, 1984; Lockridge, 1983). However, both voluntary organisation growth and fertility decline have been linked to economic modernisation (Anderson, 1971; Brown & Guinnane, 2007; Davis & Blake, 1956; Guinnane, 2011; Lundkvist, 1980). Thus, there is a need for individual-level studies that can account for confounding factors. Individual-level studies have shown that fertility limitation varied in accordance with religious affiliation (Livi-Bacci, 1986; McQuillan, 1999; Praz, 2009), and individual-level studies of the impact of voluntary organisation membership have been limited to religious groups (Junkka & Edvinsson, 2016). However, the impact of secular organisations has been studied in developing countries, showing how the organisations work as channels of diffusion of birth control information between members (Valente, 1996) or as networks of social relations that connects ideational or economic structural changes to individual fertility decision making (Barber, Pearce, Chaudhury, & Gurung, 2002).

The aim of this study is to investigate how participation in and exposure to secular voluntary organisations was associated with marital fertility during the European fertility transition from 1880 to 1949. As far as we know, this is the first study to investigate the relationship between individual-level membership in secular voluntary organisations and couples' fertility outcomes during the historical European transition. Additionally, the study contributes by differentiating between men's and women's participation, which makes it possible to show how the effect was mediated by gender. Finally, by investigating both participation and exposure within the same population, this study can contribute to the literature by showing how voluntary organisations affected not only the members' behaviours but also fertility in the rest of society.

The voluntary organisations are theoretically interesting for the explanation of the European fertility transition in two ways. First, they represent delimited social networks with distinct ideational norms that might impact fertility behaviours, and specifically, the idea of respectability, which became connected to birth control practices and small families (Ambjörnsson, 1993; Horgby, 1993; Kling, 2007). Ideational factors refer to social norms, which in turn affected couples' fertility decisions. Individualisation, working through secularisation, is seen as the main force behind ideational change, showcasing that fertility decisions were transferred from the society to the individual couple (Cleland & Wilson, 1987; Lesthaeghe & Surkyn, 1988). Secondly, voluntary organisations represent networks of social interactions that connect individuals across old traditional boundaries of family and community through voluntary relations, enabling the diffusion of norms and values. The diffusion hypothesis originates from the assertion that fertility change is not solely an adaptation to new economic, demographic and social structures, but also a reflection of the spread of certain attitudes and behaviours (Casterline, 2001). Diffusion mechanisms have been identified as being important for the European fertility transition, creating patterns of fertility which followed cultural and linguistic boundaries (Knodel & Walle, 1979; Watkins, 1986). By drawing on social network theory, this study connects ideational factors with diffusion mechanisms. It argues that reproductive behaviours, as any form of action, are not simple outcomes of personal attributes of individual couples but are shaped within a context of social relations. Decisions are influenced by the norms and values persistent within the social networks of which they are a part. New attitudes and behaviours are diffused through social interaction mechanisms, by learning from each other or by conforming to social pressures (Bernardi & Klaerner, 2014; Burt, 1982; Coleman, 1986).

To study the effect of individual-level participation on fertility, we combined longitudinal demographic data on the married population in the Skellefteå region of northern Sweden from 1880 to 1949 with individual membership records from 15 unions and 13 temperance organisations. By linking these sources, we were able to measure fertility for individuals after they became members and compare their fertility to that of non-members. Also, this means that it is possible to differentiate between the effect of a husband's and a wife's participation.

Exposure effects occur as people live near a voluntary organisation. Either directly through social interactions with existing members or indirectly through the collective actions of the members, wherein they changed the same structural environment which affects fertility decisions (Bernardi & Klaerner, 2014; Hedström, 1994; Palloni, 2001). These effects were studied by linking the demographic data to contextual data on the size and location of local voluntary organisation groups, and by comparing fertility outcomes for couples in areas with a union or a temperance organisation to those of couples in areas without their presence. This, to gain insight into how the voluntary organisations affected the fertility behaviours of individuals who were not participants.

2   SETTING

In Sweden, marital fertility rates continuously decline from the 1870s to the 1930s as shown in Figure 1 (Hofsten & Lundström, 1976), approximately at the same time as fertility declined in most of Western Europe (Coale & Watkins, 1986). The transition in the northern county of Västerbotten was similar, although the level of fertility was higher and marital fertility did not start to decline until the turn of the century. The Skellefteå region consists of six parishes around the town of Skelleftå in Västerbotten County, see Figure 2. This is a region which was primarily agrarian until the early 20th century, without any substantial industrialisation and urbanisation, at least in comparison to other coastal regions in northern Sweden such as Sundsvall. Skellefteå town served primarily as an administrative centre that grew slowly. The parishes surrounding the coastal town were sparsely populated with low population growth until the 1940s and is interesting as an example of a region that experienced a fertility transition with limited urbanisation and industrialisation.

A voluntary organisation refers to organisations which fall within the Swedish term *Folkrörelsen*, the popular movement. They are defined as organisations which were ideationally driven, attracted large memberships and whose membership was voluntary (Lundkvist, 1980; Sills, 1968). At the time of the fertility transition, three forms of organisations fall within this definition: the free-churches, the temperance organisations and the workers' movements, including unions and socialist groups. These were mass movements which were distinct from previous and other contemporary movements by virtue of their size and their organisational form. The three organisations had quite different geographical distributions, and in the Skellefteå region only the temperance organisations and the workers' movement had any substantial presence. The definition of voluntary organisation excludes organisations such as the bourgeois women's movement, because their membership numbers were relatively small. Although they had a strong stance on family issues (Gordon, 1973; Kling, 2007), due to their small numbers their impact cannot be captured in a similar way to that of the other organisations.

Figure 1   *Total marital fertility in Sweden 1750–1970*
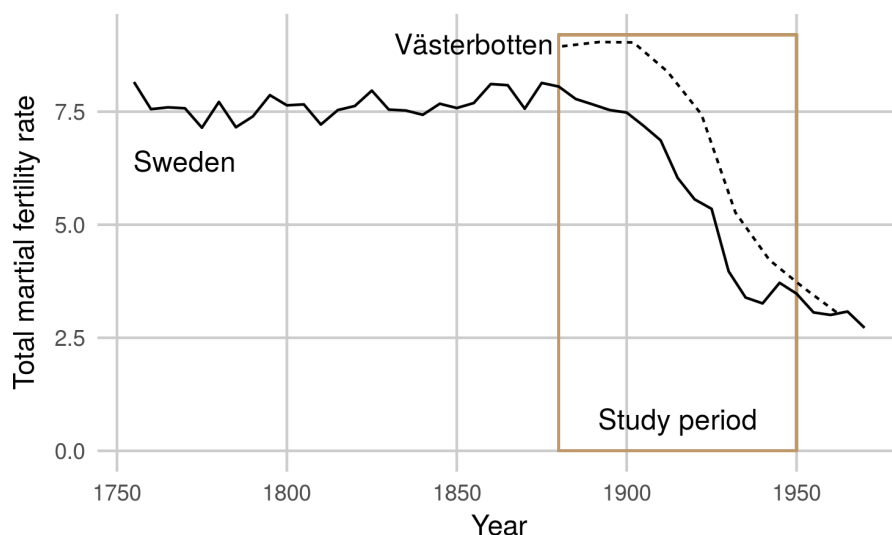
Source: Hofsten and Lundström (1976)

Figure 2   *Parishes in the Skellefteå region*


Source: Swedish National Archive (2016)

Social movements, such as the Swedish voluntary organisations, strove to change the social order across Europe and the US from the late 19th century (Gamm & Putnam, 1999; Tilly, 2004). These groups gathered around a specific ideational goal, such as: personal salvation, abstinence from alcoholic drinks, social equality or the interests of an occupational group. However, in order to achieve this goal, they worked to change the social order at large by influencing political policies or societal norms (Lundkvist, 1977; Tilly, 2004). On an individual level, becoming a member of a voluntary organisation was not only an act of affiliation, but also entailed entering into an organisational way of life. A member of a local temperance lodge or union would be part of an organisation that had its own board, held regular meetings in permanent locations, and through seminars, discussion meetings, ceremonies and rituals made the members feel they had an affinity to the group. Initiation rituals and ceremonies were especially important practices within temperance organisations, through ceremonial pledges. These rituals helped to legitimise the organisation and create a sense of closenness for their members. The organisations were often seen and spoken about as a second family, members often addressing their fellow peers as 'brothers' or 'sisters'. The members created communities that not only took care of each other, but also controlled each other. Social discipline and control was an integral part of the organisations' activities, maintained and monitored by all members, as the behaviour of other was seen to be crucial for their own status. Members had to behave respectably and in a controlled manner not only within the organisation, but also outside, publicly and privately. Violations were punished by sanctions, the loss of rights or expulsion (Ambjörnsson, 1998; Horgby, 1993; Lundkvist, 1977).

Both the temperance movement and the workers' movement were publicly against the promotion of contraceptive use (Levin, 1994); however, this did not mean that they were against family limitation. In practice, the temperance movement, and especially the workers' movement, was closely connected to the neo-Malthusian movement and the later *Riksförbundet för sexuell upplysinng* (Swedish organisation for Sexuality Education). Neo-Malthusian propaganda promoting the use of contraceptives was spread within the organisations, and radical factions of the workers' movement actively promoted the use of contraceptives (Kling, 2007; Levin, 1994). Although the temperance movement was publicly against the promotion of contraceptive use, high fertility was seen as a threat to sexual morality, the family and women's emancipation (Kling, 2007). The temperance organisations strove to promote abstinence from alcoholic drinks, gathering young individuals from the middle class and the skilled working class. However, membership turnover was relatively high. Although birth control was never an explicit issue for the temperance organisations, morality and restraint were of the utmost importance to the members (Frånberg, 1985; Lundkvist, 1977). The unions were more homogeneous than the temperance organisations, consisting of young working-class men (Åmark, 1986; Lundkvist, 1977). Although issues of morality and restraint were not as central to their agenda, the organisations have been shown to be associated with low fertility. The adoption of family limitation within the working class was connected to ideas about manliness and respectability within the local workers' movement in northern Sweden. Especially important for this diffusion were the women within the movement (Warg,

2002). Previous research has also found an association between the size of unions and socialist political organisation at an aggregate level and low fertility on a national scale, while there was no relationship between temperance movement size and fertility (Junkka, 2018).

Although these organisations originated in earlier social movements in Western Europe and North America, it was not until the second half of the 19th century that these movements formed into stable, lasting organisations. These organisations grew in numbers across the Western world after 1850 (Lundkvist, 1977; Tilly, 2004). In Sweden, the first temperance organisations, free-churches and unions that were established in the late 19th century had international roots, building upon existing groups such as the International Order of Good Templars, the Blue Ribbon, the Baptist movement or European labour unions (Åmark, 1986; Frånberg, 1985; Lundkvist, 1977). The two groups took quite different paths, as shown by Figure 3, although the workers' movement started later, it grew continuously until the 1940s, when it gathered more than one million members. The temperance organisation, on the other hand, only grew until around 1915, after which it declined. This also correlated with a structural shift of the member base. In the first phase of growth, the members consisted primarily of young individuals. Eventually, the organisations reached maturity and stagnation, and the recruitment of new young members tapered off. After 1915, the temperance organisations mainly consisted of older members, who aged with the organisation without any significant replacement (Lundkvist 1977). The temperance organisation was the first established in the Skellefteå region, located in the largest towns and villages of Skellefteå, Jörn and Byske. The first unions were established in the region around 1900 and then grew and spread rapidly both in the coastal area and in the inland parishes. Although both voluntary organisation types started in locations with relatively large populations, they were soon established in rural areas and spread out across the parishes.

Figure 3   *Members in Voluntary organisation in Sweden by type of organisation, 1881-1944*
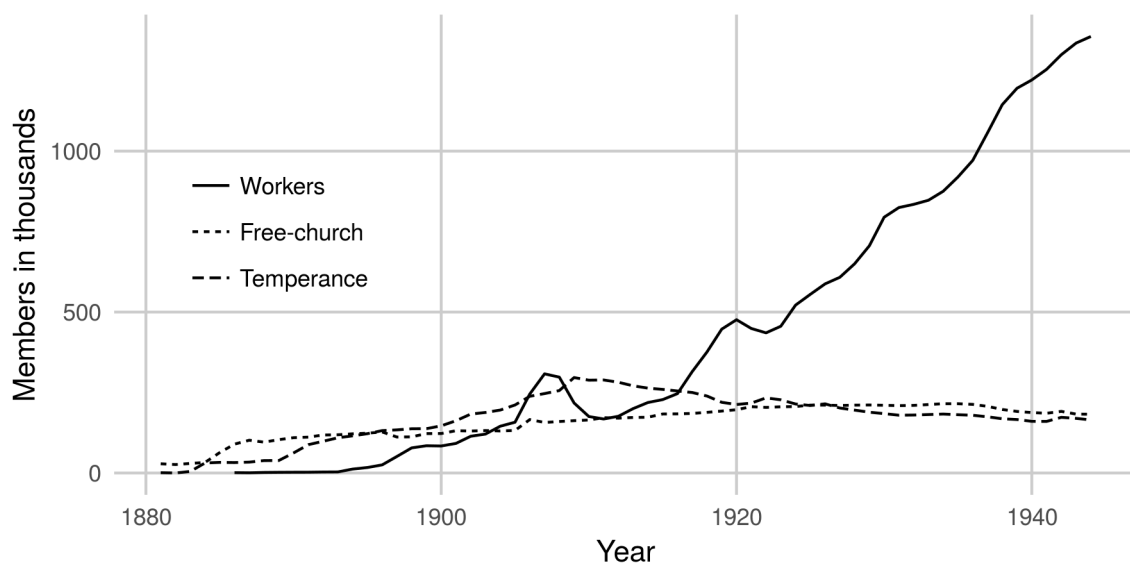
Source: Andrae (1984)

3   THEORY

This section discusses how fertility behaviours are understood from a social network perspective, and how the effects of voluntary organisations specifically are explained from an ideational, economic and collective action perspective.

3.1   SOCIAL NETWORK THEORY

Social network theory focuses on connecting structures to individual actions (Coleman, 1986). The theory asserts that, although individual action is dependent on societal structures as it limits and enables certain action, it simultaneously allows for individual agency. Specifically, individuals are embedded

into social networks, ongoing systems of social relations which shape actors interests and perceptions (Bernardi & Klaerner, 2014; Burt, 1982). Thus, the prime focus of the theory is the nature of these relationships and the patterns which they form, referred to as network structure, their size, density and diversity. Size is the number of individuals in the network, and density the number and strength of the ties between the individuals. Diversity refers to the extent individuals in the network form ties with similar actors, similarities such as age, occupation or gender (Wasserman & Faust, 1994). However, it is not the nature of social relations that are of interest in this study. Instead, the theory provides a framework for understanding how social structures are linked to reproductive practices through social interactions.

Two forms of social network mechanisms are relevant for voluntary organisations: social learning and social pressure. Social learning refers to processes where individuals observe the behaviours of others and then adopt or reject these behaviours after knowingly or unknowingly, evaluating the consequences (Bernardi & Klaerner, 2014; Casterline, 2001). The diffusion of birth control practices between social classes during the historical transition has been argued to be affected by social learning (Van Bavel, 2004; Vanhaute & Matthys, 2007). It has been suggested that social learning mechanisms were strongest in networks with weak social ties, such as between members and non-members. In networks with many weak social ties to other networks, the diffusion of new attitudes and behaviours would be easier (Granovetter, 1983).

Social pressure is a mechanism where individuals change their behaviours in order to conform to social norms. The adoption of certain reproductive practices would be an effect of individuals efforts to avoid sanctions or to gain the approval of their peers (Bernardi & Klaerner, 2014). It is suggested that the mechanism was strongest in networks with dense connections and strong social ties (Coleman, 1988; Granovetter, 1983). Lesthaeghe (1980) argues that social pressure and social control played an important role in legitimising and reproducing both high and low fertility behaviours. The voluntary organisations created systems of social control built upon relations with strong social ties, and the pressures to conform to social norms were high (Ambjörnsson, 1998; Horgby, 1993). The effect of social pressure would also grow over time; as more and more people adopted new reproductive practices, the pressure to conform to these norms would increase (Palloni, 2001). Additionally, we can assume that the effect would increase the longer an individual was connected to others in a network.

3.2   IDEATIONAL FACTORS

According to the theory, the mechanisms, in turn, work to diffuse structural changes within networks. A number of ideational, economic and social factors are of importance in connection to voluntary organisations and fertility. Ideational factors refer to norms and values which, in turn, affect fertility decisions (Lesthaeghe & Surkyn, 1988). Although the trade unions and temperance organisations did not profess any specific attitudes regarding fertility or contraceptives, they were crucial in the formation of ideas of respectability. The concept of respectability refers to the way in which men and women positioned themselves within their social group; this was most important for those where it was not seen as given, namely the working class (Skeggs, 1997).

Respectability was something which could be achieved by working-class men by forming a family and living up to the ideals of a being good father, who dedicates time to his children and wife (Horgby, 1993). The idea of respectability has been shown to be interlinked with the formation of new family ideals during the transition. In qualitative studies, Kling (2007) shows that, during the transition in Sweden, small families became associated with respectable families, and birth control became a means to conform to this ideal. This is seen both in housewife literature and workers' movement pamphlets.

Within the workers' movement, respectability was also a collective issue, promoting a conscientious way of behaviour which showed that you took responsibility not only for your work, but also for your fellow workers and your family. Family ideals were part of the workers' discourse created among the members who were seen as model citizens representing the organisation (Ambjörnsson, 1998).

3.3   ECONOMIC FACTORS

In addition to ideational effects, voluntary organisations had the potential to affect household economics. Trade unions worked to raise income and provide income security for their members. Higher income has been theorised to have been accompanied by a shift in preferences towards child quality at the cost of child quantity, during the transition. With higher incomes, parents would make

larger investments in children at the same time as the demand for another child decreased (Becker, 1960). Joining a temperance union also had some potential economic effects; by participating in temperance organisation activities the value of women's time changes, thus raising the opportunity cost of childbearing, which in turn would have lowered fertility (Guinnane, 2011; Werding, 2014).

In addition, the voluntary organisation provided financial support, which a large family previously could provide (McDonald, 2000). By joining an organisation, a member would gain access to systems of social insurance, sometimes in the form of formal private health insurance provided by societies connected to the voluntary organisations (Andersson & Eriksson, 2017). It is possible that, by gaining access to these support systems, couples would be more inclined to limit their fertility.

3.4 COLLECTIVE ACTION

The collective actions of the voluntary organisations were important in forming not only the political process, but also public discourses. As has been noted, they were ideologically driven mass movements which have been shown to have affected countries' political and social history (Lundkvist, 1980). This means that they represent an endogenous process, a feedback loop. Palloni (2001) argues that the effect of social networks on individual fertility behaviour is not limited to dyadic interactions. Through collective actions, individuals change societal structures, creating a momentum of fertility decline. The collective action of the voluntary organisations would increase the availability of education and contraceptive knowledge in society at large and strengthen social norms which legitimise fertility limitation.

One specific issue of interest is education. Although the primary focus of these organisations was not on education, spreading knowledge and educating their members was central to their activities. Through regular meetings, lectures and seminars, the organisations functioned to promote adult and child education (Ambjörnsson, 1998; Lundkvist,1977). Increased education, in turn, has been shown to lower fertility, either by lowering the cost of child quality, thus increasing the demand for quality (Becker, 1960) or by breaking down traditional normative systems (Caldwell, 1980). Voluntary organisations did not only connect individuals to structural changes; they were also a part of changing the structure. The direction of influence flows not only between members or from structure to individual, but also in the other direction, from collective action to societal structure.

4 HYPOTHESIS

The main question of this study is to what extent low fertility was associated with voluntary organisations during the demographic transition? Drawing upon the previous studies of voluntary organisation, it is proposed that the idea of respectability was formed and diffused within voluntary organisations. The voluntary organisations thus created a distinct normative environment which encouraged fertility limitation. The second proposition is that an individual member was connected to this structural environment through their social interactions with other members. Attitudes and behaviours were diffused within the voluntary organisations through social interactions. It should be stressed that the degree to which individuals were affected by others cannot be measured without information on actual interactions. This is not possible in studies of historical populations; instead, the interactions are assumed to exist between members of a delimited social network. By joining a union or a temperance organisation a man or women is assumed to have been a part of the network and, therefore, affected by the ideational norms that existed within it. Thus, the first hypothesis is that an individual who joined a voluntary organisation would have a lower probability of having a child than an individual who did not.

The third proposition is that any individual living near a voluntary organisation would also be affected by the same factors, either through direct social interactions with members or indirectly through the collective actions of the members, wherein they changed the same structural environment which affects fertility decisions. The second hypothesis is that individuals who lived near an organisation would have a lower probability of having a child than an individual who did not. Additionally, it is assumed that the effect of exposure and participation varied over the course of the fertility transition, as more and more people became members and adopted new attitudes and behaviours.

5   DATA

The analysis combines longitudinal demographic data with individual-level data on voluntary organisation membership and contextual data on voluntary organisation size. The historical demographic database POPLINK consists of linked individual-level information from church records. The unique Swedish church records allow for the creation of longitudinal life histories linked across administrative boundaries with continuous control of individuals' presence, thus providing reliable start and end dates (Westberg, Engberg, & Edvinsson, 2016). The data is suitable for event history analysis such as Cox proportional hazard regressions. The European fertility transition can be attributed to a decline in marital fertility rather than to changes in nuptiality; thus, the analysis is focused on married couples (Carlsson, 1966; Coale & Watkins, 1986). The sample consists of all married couples, 17,792, who were present in the region between 1880 and 1949 (Demografiska databasen, CEDAR, Umeå universitet 2017).

Aggregate level information on voluntary organisation size is gathered from the Popular Movement Database. The database contains yearly membership numbers for local organisations which were part of the popular movement, the free-churches, temperance organisations, unions and the Social Democratic Party between 1881 and 1945 (Andrae, 1984; Andrae & Lundkvist, 1998). Each local group represents a local organisation with their own board, holding regular meetings with their local members (Ambjörnsson, 1998; Lundkvist, 1977). However, as the membership records were not collected annually, the missing values were imputed using linear interpolation. The locations of the local groups were geocoded using the Google geocoding API (Google Developers, 2015), the process is described in greater detail by Junkka (2018). Between 1881 and 1945 the region was home to 188 unions and 166 temperance organisations. As seen in Figure 4, up to 1930 the temperance movement outnumbered the unions in terms of membership. However, the movement reached its peak in 1916, while the unions grew continuously into the 1940s, which is consistent with the national pattern (Lundkvist, 1977).

Individual-level information on union and temperance organisation membership was collected from the original membership list and linked to the demographic data. For ethical reasons, registration of members was limited to individuals born before 1915 and who entered the organisation before 1930, thereby ensuring that no living individuals were registered.

The registration process was performed by photographing 2,828 original documents of all the preserved membership records in the Popular Movement Archive in Skellefteå. The documents came from 15 unions and 13 temperance organisations, which is around 12 percent of the total number of organisations in the region, listed in Table 7 in Appendix A. Membership records were kept either in rolls, which was most common for the temperance organisations, as the example in Figure 10 shows, or as individual membership cards, most common among the unions. At a minimum, the records contained the name of the member, the year of registration and the year of entry. However, in most records, we also find information on place of residence, birth year, birth date, and the union often recorded the parish of birth. Individual membership was registered through a custom-made registration application so as to enable continuous validation and minimise errors. Finally, the linking between the membership data and the demographic data was performed by the Demographic Database at Umeå University and delivered in an anonymised form to the researcher. Linking was performed through a matching of information on gender, birth date, birth parish, standardised first name and standardised last name. The linked data consists only of an indicator of whether or not the individual was a member of a union or a temperance organisation and the first year of entry into that organisation type. The linking keys are held by the Demographic Database.

Table 1   *Number of transcribed members and organisations, and number of linked members*

Voluntary organisation	Number of transcribed members and organisations				Number of linked members (Percent of transcribed)	
	Organisations	Locations	Women	Men	Women	Men
Unions	15	10	2	1784	0 (0.0 %)	1037 (58.1 %)
Temperance lodges	13	11	388	497	135 (34.8 %)	214 (43.1 %)

As previously mentioned, the registered members do not consist of a random sample but are dependent on which records were preserved in the archive. Therefore, members of large organisations, especially those with established national mother organisations, were more likely to be registered than others. The members in the sampled unions consisted on average of 26 percent of total members, and the members in the sampled temperance consisted on average of 13.6 percent. The relationship can be seen by year in Figure 4.

Figure 4   *Members in sampled and unsampled voluntary organisations in the Skellefteå region*
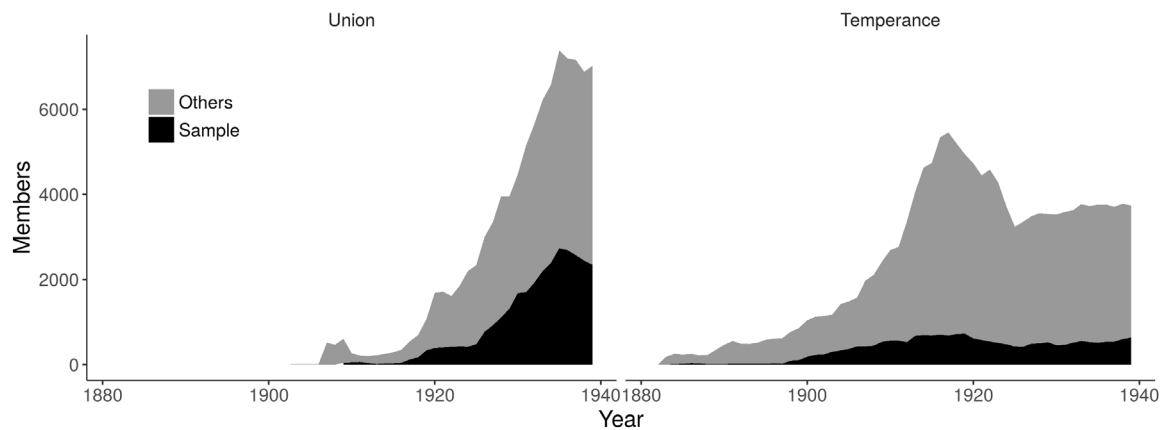
Source: Andrae (1984)

Also, not all individual records were transcribed, as transcription was limited to records where the handwriting was readable, and there were a last name and a birth year. This, in turn, was dependent on the age of the member when they joined the organisation. Birth dates and parish of birth were more likely to be annotated for older individuals than younger ones. Additionally, the longer an individual was a member, the higher the probability was that personal information was known and added to the records. Older members who were part of the organisation for a long time were more likely to be transcribed during part of the analysis. Also, the two organisations had, in general, different membership recording procedures; the unions often kept more detailed information on their members than did the temperance organisations.

Furthermore, not all records transcribed were linked, as the linking was dependent on personal information. Thus, the more complete a member's personal information was, the higher was the probability of linking. The distribution of age when joining and the date of joining was tested using Kolmogorov-Smirnov tests, which showed no differences in distribution between the registered and linked samples. Although the linked individuals do not represent a random sample of all members, they are representative of older members who were members for a longer time. Hence, they would be exposed to social learning and social pressure mechanisms for longer periods of time, which means that we can expect that the effects of participation would be stronger for this group than for the average member. In addition, as not all members were transcribed and linked, the membership status of all other individuals in the total population is unknown. Therefore, any comparison of the fertility of known members to a control group of non-members would underestimate the size of the effect of participation, as the control group could include people who were or had been a member.

6   STUDY DESIGN

One major issue when studying the effect of voluntary organisations on fertility is that the probability of joining an organisation is not similar for all individuals; it depends on individual and contextual attributes which, in turn, could also affect fertility. The growth of the Swedish voluntary organisations has been linked to industrialisation and urbanisation, attracting young individuals from the skilled working and middle classes, who had recently moved to an urban area (Lundkvist, 1980). The middle class and the urban population was also among the first to adopt fertility limitation during the transition (Dribe & Scalone, 2014; Dribe et al., 2017). Additionally, individuals tend to cluster together with their peers (McPherson, Smith-Lovin, & Cook, 2001), and the propensity to join a specific voluntary

organisation was higher if one was socially similar to the existing members (Hedström, 1994; Sandell & Stern, 1998). If the organisations consisted of individuals from social groups who were forerunners in the transition, others who were socially similar would be more likely themselves to join (Palloni, 2001). Thus, the effect of voluntary organisations on fertility is affected by selection bias.

A set of strategies was applied in this study to account for these issues. The effect of living near a voluntary organisation was adjusted for differences in neighbourhood-level and individual-level attributes using mixed effects Cox proportional hazard regressions. As the time of joining is known, effects of participation on fertility were adjusted for selection bias by constructing a matched control group with similar distributions of confounding variables for each type of joiner; men who joined a union, men who joined a temperance organisation, and women who joined a temperance organisation. By creating a matched control group before comparing fertility outcomes, it is possible to reduce selection bias in small samples, without modelling the confounders in a regression analysis. The section following will present the methods and results of the analysis of exposure, and the next section will present the analysis of participation.

7   EXPOSURE TO VOLUNTARY ORGANISATIONS

7.1   METHOD

The relationship between exposure to a voluntary organisation and married couples' fertility was analysed using mixed-effects Cox proportional hazard regressions. Using Cox regressions, it was possible to estimate average differences in fertility across the reproductive life courses of the couples, even though some of the couples' reproductive histories are censored by migration or spousal deaths (Cox, 1972). The onset of risk is set to two years before marriage, as pre-marital conceptions are common. However, this also means that the actual onset of risk for the first birth is unknown, and the analysis is restricted to later parities. The observations ended either when the wife turned 50, one of the spouses died, or they emigrated from the study area.

Having a child is an event that can occur many times across a couples' life course, and the analysis measures the average difference across the full life course. This process is modelled as multiple failure models where the hazard is stratified by parity, which means that the risk of having a third child for a couple is only compared to all other couples who also experienced two births. However, by including multiple births per couple, the analysis needs to control for differences in fertility, which is unique to each couple, either due to unobserved biological or behavioural differences (Prentice, Williams, & Peterson, 1981). This was done by estimating a random effect for each couple, which captures unobserved homogeneity of births to the same parents. The average effect of exposure across the whole life course was estimated using mixed-effects multiple failure models of the following form:

(1) $$\lambda(t) = \lambda_0(t)e^{X\beta + Zb}$$

where the risk of having a child $\lambda(t)$ is determined by a baseline hazard function $\lambda_0(t)$ and the exponentiated linear predictors. The linear predictor consists of the model matrices X and Z for the fixed effects, such as being exposed to a voluntary organisation, and the random effects, which hold identifiers for which couple the observation comes from. β and b are the corresponding fixed and random effects coefficients. The random effect is assumed to be drawn from a Gaussian probability distribution (Therneau, 2012). The models were built and evaluated using R (R Core Team, 2014) and the package coxme (Therneau & Mayo Clinic, 2016).

Exposure to an organisation is measured as a binary variable, whether or not there was an organisation in their neighbourhood or an adjacent neighbourhood within the last year. If the local group had members in a year, it is considered to be active within the location in which it is based. The dataset contains information on two geographical levels: place and parish. The Skellefteå region consists of six large parishes, which are too large for any analysis of the influence of a local organisation sinceplace locations consist of mostly small villages. Instead, the Skellefteå region was partitioned into smaller neighbourhoods, consisting of a number of nearby villages and towns and the geographical space surrounding them. The partitioning procedure was performed on each parish; the procedure is described in detail in Appendix B.

As the process creates smaller neighbourhoods from each parish, individuals living in nearby villages will have the same exposure if an organisation was established in only one of the villages. However, the area of influence of a temperance organisation would also extend beyond the neighbourhood into adjacent neighbourhoods. Thus, an individual is considered to be exposed to a union or a temperance organisation if there was an active group in their neighbourhood or in an adjacent neighbourhood within the last year. As seen by Figure 5, the subdivision into neighbourhoods captures the growth of the organisations within the parishes from 1890 until 1930, when almost all neighbourhoods within the region either were home to an active organisation or were adjacent to a neighbourhood with an active organisation.

Figure 5   *Neighbourhoods in the Skellefteå region with an active union or temperance organisation 1890–1930*
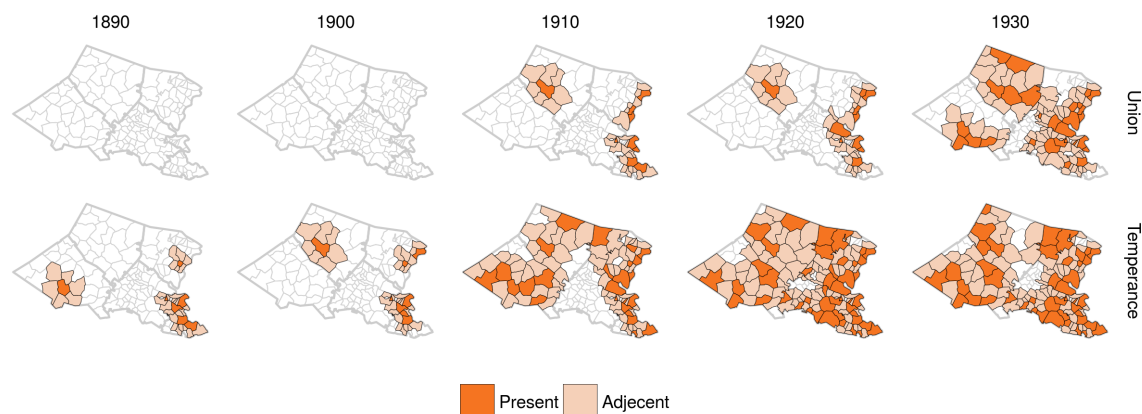
Source: Andrae (1984) and Swedish National Archive (2016)

The spatial partitioning also allows for calculations of neighbourhood-level variables, which could influence the likelihood that an organisation was established, as well as fertility. In addition to the mother parish of each neighbourhood, yearly population density and migration rate is used as proxies for neighbourhood-level urbanisation and industrialisation with a time lag of one year. The model also controls for individual attributes related to both voluntary organisation growth and fertility limitation; these are: the age of the wife, socioeconomic status, migration status, number of children as well as period effects. Because married women's occupation was under-registered, socioeconomic status was derived from the husband's occupation, coded into HISCO codes and classified using a condensed form of the HISCLASS schema (Van Leeuwen & Maas, 2011; Van Leeuwen, Maas, & Miles, 2002). The full HISCLASS schema is too fine-grained for the sample population. Instead, the 12 classes were condensed to five: Farmers, Farmworkers, Middle class, Skilled working class and Unskilled working class.

7.2   RESULTS OF THE ANALYSIS OF EXPOSURE

The results of the regression analysis are seen in Table 2; model A shows the unadjusted hazard ratios, while model B shows the hazard ratios adjusted for confounding factors. Couples living near a voluntary organisation had lower fertility, as shown by the hazard ratios in Model A; a portion of this effect was caused by couple level, and neighbourhood level differences as the hazard ratios are smaller in Model B. However, even after adjusting for confounders, the regression shows that couples who were exposed to a local union had a 16 percent lower risk of having another child than others, while the temperance organisations have an exposure effect of 4 percent lower risk. This is to a certain extent in line with previous results. On a national scale, workers' movement activity at a parish level had a stronger organisation with fertility limitation than temperance organisation activity, which showed no relationship with fertility (Junkka, 2018). The results here suggest that the relationship was strengthened by proximity, on a sub-parish level.
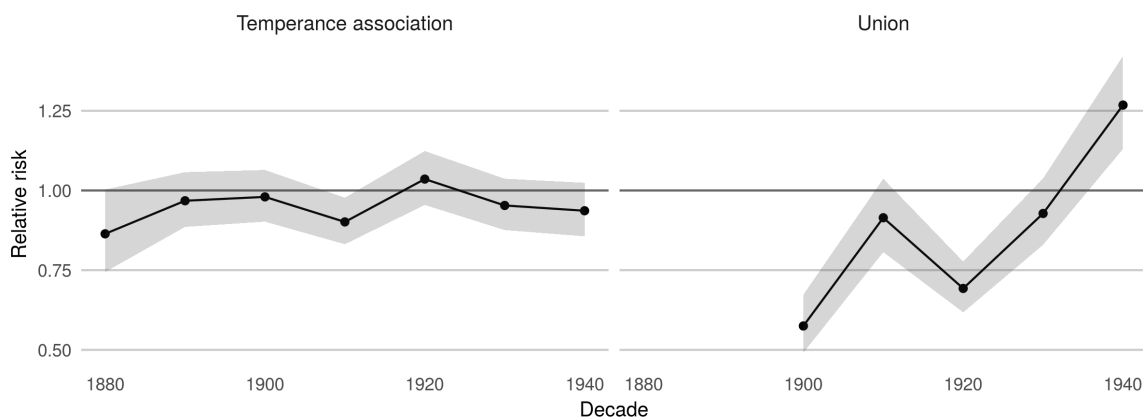
Table 2 *Voluntary organisation exposure effects on the probability of another birth as hazard ratios from a mixed effects Cox proportional hazard regression*

	Model A			Model B		
Variable	HR	Standard error	P-value	HR	Standard error	P-value
Union presence	0.567	0.016	0.000	0.840	0.018	0.000
Temperance presence	0.885	0.015	0.000	0.960	0.016	0.013

Note: Full regression results are found in Table 8 in Appendix A.

To explore whether or not the effect was constant over time, an interaction was introduced between exposure and period in two separate models for each organisation type. By calculating the predicted relative risk of having a child for couples exposed to a voluntary organisation compared to couples not so exposed, it is possible to visualise how the effect changed over time, as shown in Figure 6. The effect of temperance organisation exposure was relatively constant over time, while union exposure effects had larger variations. This is also clear by the p-values of the interactions seen in Table 9. All interactions were significant for union exposure, while the interactions were significant only between 1900 and 1910 for temperance exposure. As seen in Figure 6, Union exposure effects were strongest in 1900, then decreased in the 1910s and strengthened again in the 1920s. The sharp decline in the effect of union exposure in the 1910s could be related to the massive general strikes in 1909, when the unions lost many members all over Sweden, and thus the trust in and influence of the unions would have declined (Åmark, 1986). The positive risk in the 1940s suggests that couples who lived near a union were also among the first to increase their fertility in the post-transitional baby-boom.

Figure 6 *Predicted relative risks of having a child for couples exposed to voluntary organisations compared to couples not exposed, by voluntary organisation type between 1880 and 1949*

Note: Predicted values from Cox proportional hazard regressions shown in Table 9 in Appendix A.

In conclusion, the results show a negative relationship between voluntary organisation exposure at a neighbourhood level and couples' fertility. The relationship was stronger for unions than temperance organisations, and strongest in the initial stages of the fertility transition. The differences between organisation types could be caused by differences in networks structure. Membership turnover was much higher for the temperance organisations than for the unions (Lundkvist, 1977), which create weaker ties between their members.

The differences in effect could also have been caused by differences in potential for collective action. With an older and more stable membership base, the union had a greater potential to affect society through collective action. An active union could, thus, have raised incomes, provided financial support and increased the availability of education within their neighbourhood, to a greater extent than a temperance organisation. Structural changes which, in turn, could have incentivised fertility limitation.

# 8 PARTICIPATION IN VOLUNTARY ORGANISATIONS

8.1 METHOD

As the number of linked joiners are very few, especially female members, estimating effect in a regression while controlling for confounding factors is problematical. Instead, the joiners are matched to non-members with similar attributes using propensity score matching (PSM) before estimating effects on fertility.

PSM is used in order to reduce selection bias when estimating the effects of treatment in observational studies where a randomised experiment is not possible. The randomised experimental design is emulated by matching the treated group to a control group with a similar distribution of covariates which are assumed to predict both receiving the treatment and the outcome. For example, a person who joined an organisation is matched to a number of people who did not join but are of the same age, had the same occupation, and who lived in the same location. Thus, in theory, the only difference between the treated group and the control group is the treatment, and the difference in the outcome is the average treatment effect for the treated or the marginal effect in contrast to a conditional effect which is the result of a non-matched regression analysis (Austin, 2011). The method is especially suitable when the treatment group is much smaller than the group of potential controls, as it increases the probability of finding controls with similar attributes.

In practice, it is difficult to find exact matches for each treated individual. Instead, the individual was matched using the conditional probability of joining an organisation, their propensity score. As individuals can join an organisation at different points in time, the treatment is time-varying, and an estimation of the propensity to join using standard logistic regressions is not suitable. Cox proportional hazard regressions are better suited to estimate time-varying events with censoring. The propensity to join is, therefore, the linear predictor from a Cox regression. The matching procedure follows the methodology set up by Lu (2005).

As the outcome of interest is differences in marital fertility, being in a marital relationship is a criterion for matching in addition to the propensity score. However, as pre-marital conceptions are common, marital relationship often starts much earlier than marriage. Thus, the onset of the risk of joining is set to two years before marriage. This means that any member who joined more than two years before marriage is excluded from the PSM analysis.

Figure 7 *Illustration of risk states across individual life episodes*
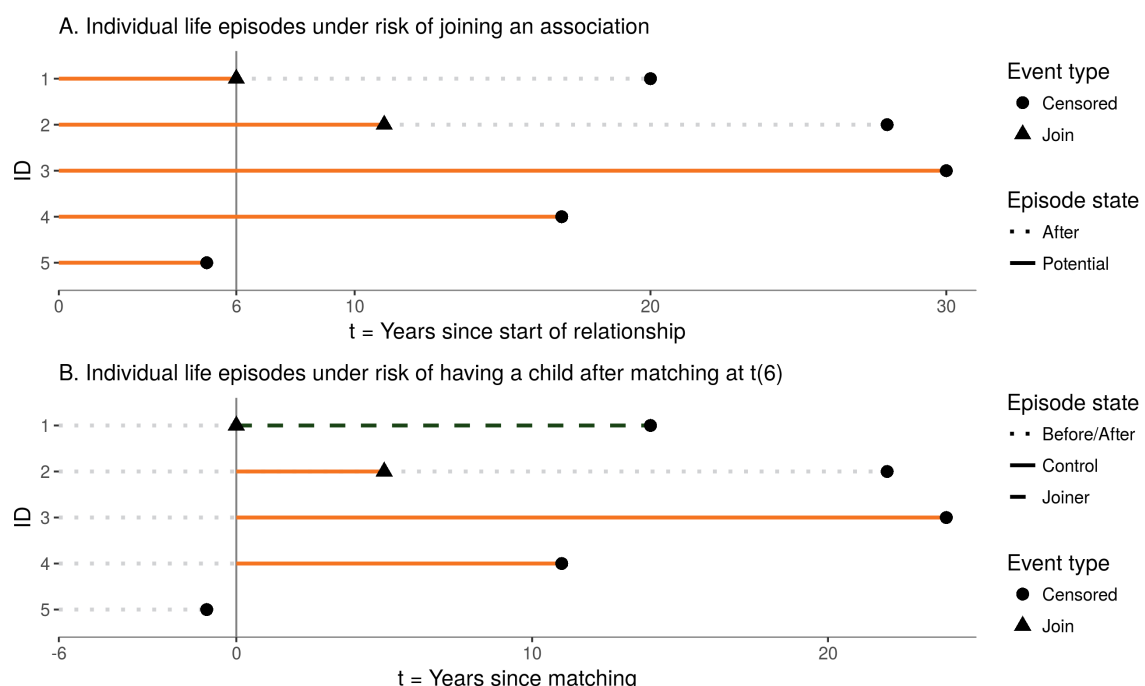
The procedure entails that reduction of bias through matching and estimation of differences in fertility is made in two separate steps, visualised in Figure 7. The first step was to estimate the hazard of joining for all individuals starting at two years before marriage $t(0)$, represented by the life episodes in graph A in Figure 7. The hazard of joining was estimated through a Cox proportional hazard model with time-varying covariates, of the following form:

$$(2) \qquad \lambda_q(t) = \lambda_0(t)e^{X_q(t)\beta}$$

where $\lambda_q(t)$ is the hazard for individual q at time t. Estimation was performed on life episodes similar to ones in Graph A in Figure 7. Matching was performed sequentially in chronological order for each failure time, where matched pairs were excluded from the next sequence (Lu, 2005). In graph A in Figure 7 the first failure time occurs as individual 1 joins at time $t(6)$. At this point, all individuals except individual 5 are potential controls, including individual 2 who did not join until $t(11)$. A future member was a potential control up until when they joined an organisation. For time t when an individual joined, the linear predictors for all possible controls were extracted. For individual q at time t the propensity score is thus:

$$(3) \qquad m_q = X_q(t)\beta$$

This represents the propensity to join at time t given the covariate distribution just before time t (Lu, 2005). In practice, each joiner was matched to three controls with the closest propensity score using the R package Matching (Diamond & Sekhon, 2013; Sekhon, 2011). In graph A in Figure 7 individual 1 is matched to the three controls with the closest propensity score, individual 2, 3, and 4.

The next step is to estimate differences in fertility between the joiners and the controls. The onset of risk of having a child for the matched sample is set to the timing of matching. In graph B in Figure 7 the onset of risk is set to $t(6)$ when individual 1 joined, and individuals 2, 3, 4 were matched to the joiner. Differences in the probability of another birth between members and non-member controls after matching were estimated using multiple failures mixed-effects Cox proportional hazard regressions described by equation (1).

8.2 MATCHED SAMPLE

Matching was only performed on members who joined after they had started a relationship and before their reproductive life course ended. The majority of the male union members joined during their reproductive life, while most of the male and female temperance members joined before, as seen in Table 3. Joining was often associated with the timing of partnering and marriage, seen in Figure 8, as most people joined in the years just before or after partnering. The probability of joining an organisation then declines over the course of their reproductive life courses.

Table 3   *Number of members and control in each group*

Member	Joined before partnering (two years before marriage)	Joined after partnering	Matched joiners	Matched controls
Male union	385	652	652	1956
Female temperance	90	45	45	135
Male temperance	138	76	76	228

Figure 8   *Distribution of timing of joining in relation to timing of partnering*
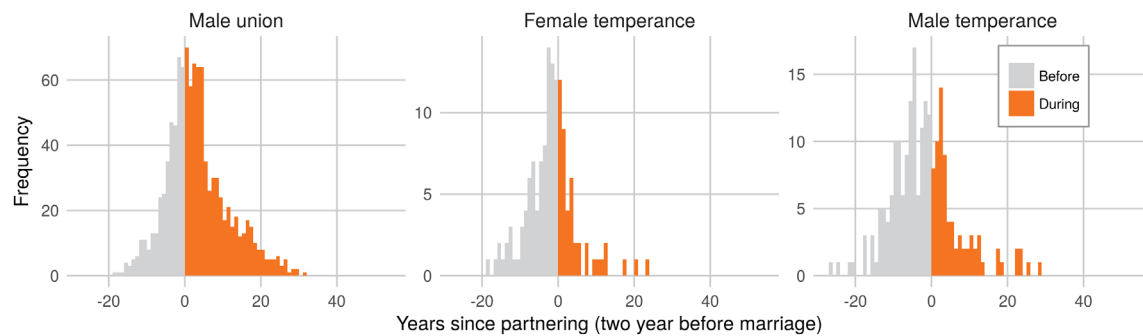
As mentioned earlier, the primary goal of the PSM procedure was to reduce bias in estimation of the effect of participation on fertility outcomes by creating a control group with a similar distribution of covariates as the members. Matching was performed on the same individual and neighbourhood attributes as used in the analysis of exposure effects. On an individual level, the covariates are their age, migration status, socioeconomic status, net fertility (number of surviving children), and period. Additionally, to enable assessment of gender-specific effects, the matching procedure also includes an indicator for whether their partner had ever been a temperance member. At a neighbourhood level, the covariates are the presence of a union or a temperance organisation, proportion migrants, population density and parish affiliation. The estimated parameters from the Cox regression of the propensity to join is shown in Table 10 in Appendix A.

The covariate balance was tested before and after matching, as suggested by Lu (2005). The distribution of covariates for members, matched controls and the total sample at the time of matching is shown in full in Tables 11, 12 and 13 in the Appendix A. The equality of distributions of variables was tested before and after matching. Categorical variables were tested using stratified Cochran-Mantel-Haenszel tests (Mantel, 1963) and continuous variables through the Kolmogorov-Smirnov test. Table 4 shows the p-values from the tests, which is the probability that the distribution of the covariate for controls and joiners are equal. As expected, most covariates were unbalanced before matching, as p-values are less than 0.05 and balanced after, above 0.05. This shows that the matched control group is similar to the joiners just before they joined an organisation. Any differences in fertility outcomes measured after that moment in time are not caused by selection bias, but rather by the act of joining an organisation or by some other factor for which the matching has not controlled.

Table 4   *P-values from tests of covariance balance before and after matching using Cochran-Mantel-Haenszel and Kolmogorov-Smirnov tests of equality of categorical and continuous distributions*

	Union		Mother temperance		Father temperance	
Variable	Matched	Unmatched	Matched	Unmatched	Matched	Unmatched
Socioeconomic status	0.814	0.000	0.973	0.623	0.963	0.035
Age of ego	0.876	0.567	0.761	0.008	0.877	0.223
Ego migration status	0.946	0.701	0.551	0.693	1.000	0.195
Temperance member partner	0.965	0.591	0.478	0.000	0.901	0.000
N children	0.997	0.000	1.000	0.870	1.000	0.375
Union presence	0.350	0.391	0.828	0.509	0.340	0.040
Temperance presence	0.544	0.041	0.878	0.703	0.914	0.865
Proportion migrants	0.221	0.000	0.941	0.193	0.929	0.002
Population density	0.586	0.000	0.947	0.001	0.936	0.000
Parish	0.792	0.000	0.995	0.000	0.866	0.000
Decade period	0.170	0.000	0.634	0.341	0.853	0.000

8.3   RESULTS OF THE ANALYSIS OF PARTICIPATION

Differences in fertility between members and non-members are estimated using mixed effects Cox proportional hazard regressions. Table 5 shows the estimated hazard ratios from the regressions, which is the difference in the average hazard of having another child across all birth intervals after the first for individuals who joined a voluntary organisation compared to the non-member controls. The most substantial difference is seen for male temperance members who had a 38.3 percent lower risk of having another child, male union members also had a significant negative risk of 19.3 percent. Although the point estimate for women who joined a temperance organisation was negative, suggesting a 9.4 percent lower risk, the effect was not statistically significant. However, the sample size of female temperance members is very small (N=44). Therefore, the larger p-values could be caused by sample size rather than larger variations.

Table 5   *Differences in hazard of experiencing a birth between voluntary organisation members and a matched control group, by type of joiner*

	Union		Mother temperance		Father temperance	
Variable	HR	P-value	HR	P-value	HR	P-value
Membership	0.807	0.000	0.906	0.740	0.617	0.003
Summary statistics						
N members	652		45		76	
N controls	1,956		135		228	
N observations	6,648		556		1,049	
Events	4,294		405		769	
SD of individual-level random effect	2.730		3.827		2.475	
P-value	0.000		0.000		0.000	

Note: Hazard ratios (HR) and P-values estimated using mixed-effects Cox proportional hazard regressions.

Similarly, to the effect of exposure, it is quite possible that the effect of participation changed over time. The variation in the effect over time is analysed by introducing an interaction between participation and period into the regression. The results show that none of the interactions was significant, as seen in Table 14. However, this can be due to limitations in sample size, and the point estimated does suggest some interactions. This is explored further by visualising the predicted relative risks of having a child for members compared to non-member controls by type of joiner in Figure 9. As none of the interactions was significant, the figure shows only the point estimates. The visualisation suggests that the effect of participation for male union members were constant over time and for female temperance members the effect was negative before 1920 and positive in the 1940s. The negative relationship for male temperance members grew stronger until the 1910s after which it weakened until the 1940s. The effect of joining a temperance organisation seems to have strengthened until the 1920s while the effect of joining a union was constant over time, however, as none of these interactions was statistically significant it is difficult to determine if this represents actual changes or reflects random variation.

Although by balancing the covariate distribution of non-member controls to members before the regression analysis we can estimate effects from small samples, the effect measured is limited to the sample population. The population consists of all joiners of a portion of the voluntary organisations in the region who joined after they became at risk of having a child. Thus, the effect could be different for those who joined long before marriage. This would have been a preventive effect where members got exposed to, observed, learned and evaluated the attitudes and behaviours of their peers long before they started to consider having children. To assess if this effect was different, we estimated the preventive effect in a separate analysis. However, as these individuals joined at least two years before they married, it is not possible to create a matched control group in the same fashion. Instead estimations of fertility outcomes are adjusted for confounders using a mixed effects Cox proportional hazard regression.

Figure 9   *Relative risk of another birth for members compared to non-member controls, by type and decade*
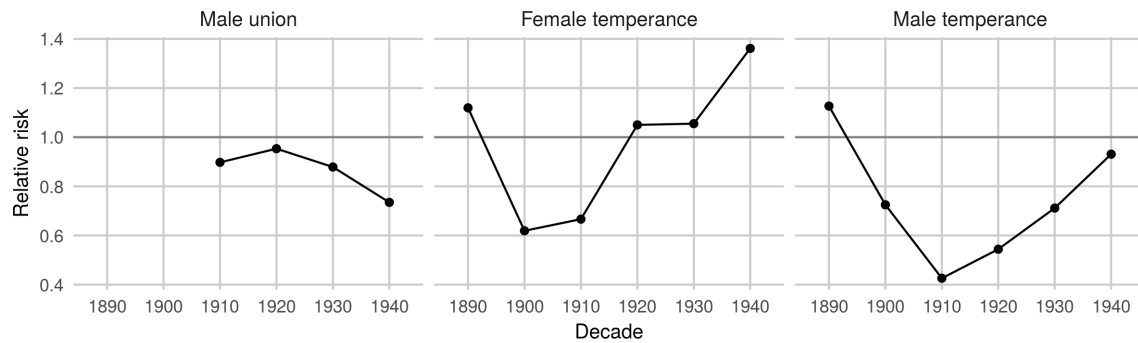
Note: *Predicted values from mixed-effect Cox proportional hazard regressions. See full regression results in Table 14 in Appendix A.*

Table 6   *Effect of voluntary organisation participation before partnering on the probability of another birth as Hazard ratios from a mixed effects Cox proportional hazard regression*

Variable	HR	Standard error	P-value
Husband a union member	0.773	0.054	0.000
Husband a temperance member	0.851	0.092	0.079
Wife a temperance member	0.925	0.107	0.470

Note: *This is a condenced version of the full regression output in Table 15 in Appendix A.*

The estimated preventive effect is negative for men who joined a union or a temperance organisation, as shown in Table 6. However, compared to individuals who joined after partnering, the effect size is slightly larger for union members (3.4 percentage points difference) and much smaller for temperance members (23.4 percentage points difference), and only significant for union members. The point estimate for women who joined a temperance organisation before the onset of risk is positive but with a large confidence interval. These differences could be caused by differences in membership turnover. The temperance organisations had a much higher membership turnover than the unions (Lundkvist 1977). Thus, a man who became a union member before marriage would be much more likely to remain as a member than if he joined a temperance lodge. Additionally, the average temperance member was younger when he joined as compared to a union member, while the average time between joining and partnering was longer, as seen in Figure 8. As the propensity to drop out was higher for younger individuals than older, some of the men would not have been a member of a temperance organisation any longer when they started to have children. This would mean that the strength of the ties within the network would have been weaker and the number of ties to the temperance organisation would have been fewer. Thus, the effect strengthened the longer an individual was a member. Finally, as the sample sizes are small for temperance members, the inclusion of control variables decreases the ability to estimate parameter variability and therefore, the uncertainty in the model increases and with that the confidence intervals of the parameter estimates. However, the results for the preventive effect point in the same direction as the results from the matched samples.

9   CONCLUDING DISCUSSIONS

The results of this investigation show that voluntary organisations were associated with fertility limitation during the demographic transition. More specifically, men who joined a union or a temperance organisation had a lower risk of having another child than matched non-members, while women who joined a temperance organisation did not. The results also show a relationship between low fertility and living near a voluntary organisation. These effects were present independently of differences in individual as well as contextual attributes, such as age, socioeconomic status, migration

history or population density. These results support previous findings since couples' fertility limitation was not just associated with voluntary organisation activity on a parish level (Junkka, 2018). Rather, it can also be seen on a sub-parish level over the course of the whole fertility transition. In addition, the connection to participation was not limited to free church membership (Junkka & Edvinsson, 2016), it was also found among union and temperance organisation members, which is in line with studies on contemporary populations (Barber et al., 2002; Valente, 1996).

Although the estimates presented here are adjusted for differences in confounders, either through PSM or by modelling the effects in regression analysis, it is possible that the effects of joining were caused by some latent variable, that was not accounted for. As this is an observational study, we do not know the attitudes of the people who join an organisation. It is possible that the organisations attracted individuals who already saw fertility limitation as an acceptable and desirable form of behaviour, and that these attitudes did not correlate with where they lived, their socioeconomic status, net fertility, migration history or any other individual or neighbourhood level attribute which was controlled for in the analysis. Thus, the effect of joining that is visible in the analysis, could be caused by a selection effect, wherein people who already had positive attitudes towards birth control were also more likely to join. Due to this limitation, the analysis presented here should not be interpreted as evidence of a causal relationship between voluntary organisations and fertility limitation, it merely shows an association between participation in and exposure to voluntary organisations. A possible explanation of this pattern is that the voluntary associations facilitated a diffusion of an increased use of birth control both among their members and the rest of society through social network mechanisms.

Overall, the results suggest that the adoption of fertility limitation behaviours during the European fertility transition was affected by social network mechanisms. Both social learning and social pressure mechanisms would have been important but in different ways. The organisations functioned as bridges between individuals over traditional social boundaries of family and kin (Lundkvist, 1980). Initially, the organisations would create weak social ties between its members facilitating many bridges of social interaction between members with different backgrounds. Weak ties would strengthen social learning mechanisms (Granovetter, 1983) and thus, enable the diffusion of new attitudes and behaviours. Over time, the members would form stronger ties, and new attitudes formed into social norms around the idea of respectability and appropriate family formation behaviours (Ambjörnsson, 1993; Horgby, 1993; Kling, 2007). The social pressure to conform to these norms would be high. Couples in proximity to the organisations would be more likely than others to be connected to a member through weak social ties than other couples, which would strengthen social learning mechanisms (Granovetter, 1983). Thus, we also see exposure effects of voluntary organisations on couples' fertility. However, they would not be exposed to the same social pressures as members, and therefore the effect on fertility was weaker. Additionally, people in proximity to the voluntary organisations, members and non-members, would be affected by the collective actions of the organisations (Palloni, 2001), wherein the availability of education, economic support, and the strength of societal norms that incentivise fertility-limitation would be greater. However, the exposure effect was stronger for unions than temperance organisations. This can either be a result of the temperance organisations higher membership turnover, which would weaken any social ties created to the rest of society, or that the collective action of temperance organisations did not expand beyond their explicit ideational goal of abstinence from alcohol, to larger social issues of family formation and morality, to the same extent as the workers movement.

The effect of participation also differed by gender. Although the sample size of female members was low, there seem to be much smaller differences in fertility between female members and non-member controls, compared to men. This could indicate that men's attitudes towards birth control were more important than women's, which is in line with previous studies (Fisher, 2006). The gender effect could also be related to the specific ideational effect of the temperance organisations and the unions. The core membership base consisted of men, and previous studies argue that the meaning of birth control for men's identities became incorporated into manliness within these organisations. Fertility limitation was a part of the construction of manliness, a way of becoming a respectable worker and citizen, by taking responsibility for ones' family. A large family was thus a sign of poverty and irresponsibility (Ambjörnsson, 1993; Horgby, 1993; Kling, 2007).

Even though the results of this study provide strong evidence to support the link between social networks and fertility decline, we should be cautious about drawing conclusions on causality, as this is but one study - a study with limitations. The findings here could be specific to the setting.

Frånberg (1983) argues that the temperance organisations of northern Sweden had a distinctiveness, which differentiates it from the rest of Sweden and Europe. Additionally, the sample population is representative of a peripheral rural population, and the social network effects might be different in more densely populated areas with different social and economic structural conditions. Also, the results are weakened by data limitations. Although the sample size of union members is substantial (909 men), the sample size of temperance organisation members is relatively small (134 women and 203 men) in relation to how many were actual members. However, they are representative of active temperance members who were part of the organisation for an extended period. In addition, this also means that the control group could have contained members who were not identified as members, and therefore the results would underestimate the size of the effect.

Still, despite these limitations, the results of this article suggest the existence of individual-level social network effects on fertility in a historical population. Social network effects are not something that occurred after the demographic transition but were in effect during the transition, affecting the pace of fertility decline. This suggests that reproductive decisions were not simple responses by the individual couple to structural changes but also shaped within the social networks of which they were a part.

In conclusion, the results of this article show the usefulness of a social network perspective for the study of historical fertility transitions. The context of social action matters for demographic outcomes not only in post-transitional societies (Balbo & Barban, 2014; Bernardi & Klaerner, 2014; Keim, 2011) but also during the transition. By viewing the transition as not just a simple shift from traditional values to rationality through individualisation, but rather as a process where family and parenthood is given meaning in a new context, we can better identify and model the process of influence and change. Future research which connects individuals into social networks beyond that of family and kin will be likely to give greater insights into both historical and contemporary demographic processes.

ACKNOWLEDGEMENTS

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APPENDIX A

The dataset used in this analysis is available at the Demographic database, CEDAR, Umeå university with the identifier http://dx.doi.org/10.17197/U16003. The code used to produce the analysis is documented in two repositories on GitHub. The data preparation procedure is available at https://github.com/junkka/poplink2018, and the code used to produce the analysis is available at https://github.com/junkka/hlcs2018.

Figure 10 *Membership roll from Finnfors Blåbandsförening 1913.*

Table 7   *Number of transcribed members by organisation and gender*

Type	Parish	Place	Organisation	Men	Women
Union	Bureå	Bureå	Paper Industry	94	0
		Bureå	Sawmill	615	0
		Fahlmark	Forestry	7	0
	Byske	Åbyn	Transportation	53	0
		Brännfors	Transportation	36	0
		Renholmen	Sawmill	141	0
		Storbränna	Forestry	3	0
	Skellefteå	Boliden	Mining	93	1
		Skellefteå	Factory Workers	129	0
		Skellefteå	Metal Industry	77	1
		Skellefteå	Telegraph	215	0
		Skellefteå	Transportation	24	0
		Skellefteåhamn	Railway Workers	186	0
		Skellefteåhamn	Metal Industry	108	0
Temperance	Bureå	Bureå	Blue Ribbon	12	5
		Burvik	Blue Ribbon	3	1
		Fahlmark	IOGT (International Order of Good Templars)	68	71
	Byske	Byske	IOGT (International Order of Good Templars)	38	32
		Fridhem	IOGT (International Order of Good Templars)	6	0
		Fridhem	IOGT (International Order of Good Templars)	18	7
		Selet	Blue Ribbon	23	17
		Tåmeträsk	Blue Ribbon	16	8
	Jörn	Jörn	Blue Ribbon	2	4
		Jörn	IOGT (International Order of Good Templars)	109	82
	Norsjö	Norsjö	IOGT (International Order of Good Templars)	107	82
	Skellefteå	Boliden	IOGT (International Order of Good Templars)	50	39
		Finnfors	Blue Ribbon	45	40

Table 8   *Voluntary organisation exposure effects on the probability of another birth as Hazard ratios from a mixed effects Cox proportional hazard regression*

Variable	Model A			Model B		
	HR	Standard error	P-value	HR	Standard error	P-value
Union presence	0.567	0.016	0.000	0.840	0.018	0.000
Temperance presence	0.885	0.015	0.000	0.960	0.016	0.013
Parish						
Skellefteå rural (ref.)				1.000		
Skellefteå town				1.047	0.047	0.330
Byske				0.962	0.023	0.094
Bureå				1.398	0.046	0.000
Norsjö				1.066	0.028	0.022
Jörn				1.209	0.032	0.000
Proportion migrants				0.888	0.010	0.000
Log of population density				0.966	0.007	0.000
Decade						
1880				0.990	0.023	0.650
1890				0.999	0.019	0.950
1900 (ref.)				1.000		
1910				0.948	0.018	0.004
1920				0.702	0.022	0.000
1930				0.449	0.026	0.000
1940				0.589	0.029	0.000
Socioeconomic status						
Farmers (ref.)				1.000		
Farm workers				0.875	0.037	0.000
Middle class				0.825	0.030	0.000
Skilled workers				0.797	0.026	0.000
Unskilled workers				0.883	0.016	0.000
Husband a migrant				0.917	0.020	0.000
Wife a migrant				0.974	0.018	0.140
Log of net fertility				1.004	0.039	0.910
Wife's age squared				0.999	0.000	0.000
Summary statistics						
N observations	105,445			105,445		
N events	51,035			51,035		
Degrees of freedom	3			24		
Log-likelihood	-404,749.000			-406,949.000		
Wald test P-value	0.000			0.000		
N unique couples	17,792			17,792		
SD of couple-level random effect	2.750			2.144		

Table 9   *Interaction effects of voluntary organisation exposure and period on couples hazard of experiencing a birth*

Variable	Temperance interaction model			Union interaction model		
	Hazard ratio	Standard error	P-value	Hazard ratio	Standard error	P-value
Union presence	0.844	0.018	0.000	0.575	0.060	0.000
Temperance presence	0.980	0.028	0.470	0.970	0.019	0.110
Parish						
Skellefteå rural (ref.)	1.000			1.000		
Skellefteå town	1.044	0.047	0.360	1.078	0.051	0.140
Byske	0.963	0.023	0.098	0.998	0.027	0.930
Bureå	1.411	0.046	0.000	1.418	0.050	0.000
Norsjö	1.066	0.028	0.022	1.021	0.033	0.520
Jörn	1.210	0.032	0.000	1.211	0.036	0.000
Proportion migrants	0.888	0.010	0.000	0.893	0.012	0.000
Log of population density	0.967	0.007	0.000	0.961	0.008	0.000
Decade						
1880	1.007	0.027	0.810			
1890	1.008	0.026	0.760			
1900 (ref.)	1.000			1.000		
1910	1.009	0.035	0.800	0.890	0.020	0.000
1920	0.665	0.041	0.000	0.736	0.025	0.000
1930	0.454	0.041	0.000	0.409	0.034	0.000
1940	0.603	0.049	0.000	0.438	0.043	0.000
Farmers (ref.)	1.000			1.000		
Farm workers	0.875	0.037	0.000	0.864	0.051	0.004
Middle class	0.826	0.030	0.000	0.776	0.035	0.000
Skilled workers	0.797	0.026	0.000	0.756	0.031	0.000
Unskilled workers	0.883	0.016	0.000	0.883	0.019	0.000
Husband a migrant	0.918	0.020	0.000	0.915	0.024	0.000
Wife a migrant	0.974	0.018	0.150	0.975	0.021	0.240
Log of net fertility	1.003	0.039	0.940	0.952	0.045	0.270
Wife's age squared	0.999	0.000	0.000	1.000	0.000	0.000
Interactions						
Temperance presence * 1880	0.882	0.073	0.084			
Temperance presence * 1890	0.988	0.038	0.740			
Temperance presence * 1900 (ref.)	1.000					
Temperance presence * 1910	0.920	0.041	0.040			
Temperance presence * 1920	1.057	0.045	0.220			
Temperance presence * 1930	0.973	0.045	0.540			
Temperance presence * 1940	0.956	0.055	0.410			
Union presence * 1900 (ref.)				1.000		
Union presence * 1910				1.590	0.066	0.000
Union presence * 1920				1.205	0.065	0.004
Union presence * 1930				1.614	0.069	0.000
Union presence * 1940				2.205	0.076	0.000
Summary statistics						
N observations	105,445			81,399		
N events	51,035			35,785		
Degrees of freedom	30			26		
Log-likelihood	-406,937			-274,310		
Walt test P-value	0.000			0.000		
N unique couples	17,792			14,753		
SD of couple-level random effect	2.144			2.245		

Note: Estimated using mixed effects Cox proportional hazard regressions.

Table 10   *Hazard of joining a union or a temperance organisation for men and women in the Skellefteå region*

Variable	Male temperance			Male union			Female temperance		
	HR	Standard error	P-value	HR	Standard error	P-value	HR	Standard error	P-value
Net fertility	1.210	0.096	0.047	1.197	0.030	0.000	1.250	0.160	0.163
Spouse a temperance member	6.983	0.417	0.000	0.773	0.385	0.504	17.000	0.411	0.000
Ego age squared	0.916	0.025	0.001	0.960	0.008	0.000	0.887	0.039	0.002
Ego live in birth parish	1.412	0.296	0.243	1.177	0.116	0.159	1.114	0.396	0.785
Socioeconomic status									
Farmer (ref.)	1.000			1.000			1.000		
Farm worker				1.308	0.425	0.527	1.825	1.054	0.568
Middle class	3.023	0.414	0.007	0.475	0.305	0.014	2.274	0.618	0.184
Skilled worker	2.544	0.380	0.014	1.055	0.197	0.785	2.299	0.546	0.127
Unknown	0.718	0.481	0.492	1.297	0.179	0.147	1.160	0.571	0.795
Unskilled worker	1.170	0.305	0.606	3.464	0.127	0.000	1.644	0.407	0.222
Parish									
Skellefteå (ref.)	1.000			1.000			1.000		
Byske	1.744	0.425	0.191	1.676	0.119	0.000	2.118	0.454	0.099
Bureå	11.000	0.566	0.000	4.142	0.132	0.000	6.260	0.598	0.002
Norsjö	3.857	0.437	0.002	0.136	0.340	0.000	0.625	0.679	0.489
Jörn	4.333	0.492	0.003	0.160	0.301	0.000	1.283	0.560	0.657
Proportion migrants									
<0.1 (ref.)	1.000			1.000			1.000		
0.1-0.14	0.863	0.454	0.746	1.023	0.132	0.864	0.426	0.558	0.126
0.15-0.23	1.902	0.433	0.138	1.372	0.136	0.020	1.144	0.482	0.780
>0.23	1.502	0.457	0.373	1.174	0.149	0.284	1.653	0.464	0.279
Population density									
<0.21 (ref.)	1.000			1.000			1.000		
0.21-0.87	4.164	0.357	0.000	0.663	0.168	0.014	1.916	0.444	0.143
0.88-2.6	2.586	0.431	0.027	0.702	0.155	0.022	1.089	0.498	0.864
>2.6	0.289	0.749	0.098	0.785	0.157	0.123	0.096	0.875	0.007
Union presence	0.796	0.383	0.552	1.029	0.101	0.774	1.252	0.449	0.617
Temperance presence	0.967	0.291	0.909	0.897	0.100	0.278	1.001	0.378	0.998
Decade									
1880	1.166	1.086	0.888						
1890	0.836	0.542	0.742				0.685	0.627	0.546
1900	2.919	0.403	0.008	0.018	0.455	0.000	0.801	0.522	0.670
1910	0.962	0.446	0.930	0.306	0.128	0.000	0.786	0.481	0.616
1920 (ref.)	1.000			1.000			1.000		
1930	0.895	0.368	0.763	0.383	0.095	0.000	0.456	0.457	0.086
Summary statistics									
N observations	165158			137713			153358		
N event	77			654			45		
Log-likelihood	-648			-5463			-378		
P-value	0.000			0.000			0.000		

Note: Estimated parameters from Cox proportional hazard regressions.

Table 11   *Mean values of covariate for female temperance members, controls and the total sample population at time of matching*

Variable	Members	Controls	Total population
Parish			
Skellefteå town/rural	26.7	23.7	56.8
Bureå	26.7	29.5	15.3
Byske	20.0	20.9	4.8
Norsjö	17.8	18.0	12.6
Jörn	8.9	7.9	10.4
Socioeconomic status			
Farmers	22.2	33.1	26.1
Farm workers	2.2	1.4	1.6
Middle class	8.9	6.5	7.5
Skilled workers	13.3	15.1	10.0
Unknown	11.1	12.9	19.9
Unskilled workers	42.2	30.9	35.0
Union presence			
False	71.1	70.5	65.3
True	28.9	29.5	34.7
Temperance presence			
False	40.0	38.1	36.9
True	60.0	61.9	63.1
Live in birth parish			
False	42.2	50.4	38.3
True	57.8	49.6	61.7
Proportion migrants			
<0.1	22.2	17.3	22.2
0.1-0.14	11.1	8.6	25.1
0.15-0.23	28.9	33.8	27.5
>0.23	37.8	40.3	25.1
Population density			
<0.21	17.8	18.0	21.3
0.21-0.87	42.2	41.7	22.4
0.88-2.6	35.6	38.1	25.7
>2.6	4.4	2.2	30.5
Decade			
1920	37.8	41.7	25.5
1890	11.1	15.8	12.0
1900	17.8	18.7	17.4
1910	17.8	12.9	20.3
1930	15.6	10.8	24.8
Age of ego	22.6	22.5	24.2
Net fertility	0.9	0.9	0.6
Spouse is a temperance member			
False	82.2	85.6	99.2
True	17.8	14.4	0.8

Table 12   *Mean values of covariate for male temperance members, controls and the total sample population at time of matching*

Variable	Members	Controls	Total population
Parish			
Skellefteå town/rural	19.5	20.3	56.8
Bureå	16.9	17.9	15.6
Byske	14.3	14.6	5.1
Norsjö	29.9	26.4	12.5
Jörn	19.5	20.7	10.0
Farmers	29.9	32.5	28.0
Socioeconomic status			
Middle class	13.0	12.2	7.5
Skilled workers	15.6	13.0	10.2
Unskilled workers	33.8	32.9	34.9
Unknown	7.8	9.3	19.4
Union presence			
False	76.6	72.8	64.4
True	23.4	27.2	35.6
Temperance presence			
False	35.1	33.7	37.6
True	64.9	66.3	62.4
Live in birth parish			
False	40.3	37.4	40.9
True	59.7	62.6	59.1
Proportion migrants			
<0.1	11.7	16.7	21.6
0.1-0.14	14.3	13.4	25.3
0.15-0.23	41.6	39.0	27.2
>0.23	32.5	30.9	26.0
Population density			
<0.21	18.2	16.3	20.8
0.21-0.87	46.8	46.3	22.1
0.88-2.6	31.2	32.1	25.9
>2.6	3.9	5.3	31.1
Decade			
1920	20.8	22.0	22.8
1880	1.3	1.2	1.8
1890	10.4	6.9	13.0
1900	35.1	36.2	15.6
1910	13.0	13.4	18.1
1930	19.5	20.3	28.6
Age of ego	27.7	28.5	28.9
Net fertility	1.6	1.4	0.8
Spouse is a temperance member			
False	90.9	88.2	99.4
True	9.1	11.8	0.6

Table 13   *Mean values of covariate for male union members, controls and the total sample population at time of matching*

Variable	Members	Controls	Total population
Parish			
Skellefteå town/rural	48.3	48.4	56.8
Bureå	20.7	23.1	14.6
Byske	27.5	25.1	3.6
Norsjö	2.0	1.9	13.8
Jörn	1.5	1.5	11.2
Socioeconomic status			
Farmers	13.1	14.5	28.9
Farm workers	0.9	1.1	1.7
Middle class	2.0	1.9	8.4
Skilled workers	6.5	5.6	10.7
Unskilled workers	68.1	66.7	31.4
Unknown	9.4	10.2	19.0
Union presence			
False	61.2	61.9	59.6
True	38.8	38.1	40.4
Temperance presence			
False	27.1	26.5	31.8
True	72.9	73.5	68.2
Live in birth parish			
False	50.5	47.5	39.4
True	49.5	52.5	60.6
Proportion migrants			
<0.1	15.8	18.6	21.4
0.1-0.14	21.3	22.6	27.3
0.15-0.23	28.7	30.5	27.3
>0.23	34.2	28.4	24.0
Population density			
<0.21	10.2	11.2	20.1
0.21-0.87	13.7	13.4	21.9
0.88-2.6	27.2	28.5	27.1
>2.6	48.9	47.0	30.9
Decade			
1920	61.2	60.6	25.0
1900	0.8	1.9	22.1
1910	12.9	14.2	22.5
1930	25.1	23.2	30.4
Age of ego	29.3	29.7	29.9
Net fertility	1.8	1.8	1.1
Spouse is a temperance member			
False	98.9	99.2	99.2
True	1.1	0.8	0.8

Table 14   *Interaction effects of voluntary organisation membership and period on the hazard of experiencing a birth*

Variable	Male union HR	P-value	Female temperance HR	P-value	Male temperance HR	P-value
Membership	0.898	0.610	0.666	0.320	0.426	0.001
Decade						
1890			1.366	0.470	1.109	0.700
1900	0.765	0.270	1.385	0.200	1.129	0.340
1910 (ref.)	1.000		1.000		1.000	
1920	0.620	0.000	0.536	0.009	0.597	0.000
1930	0.333	0.000	0.271	0.000	0.390	0.000
1940	0.175	0.000	0.109	0.000	0.151	0.000
Interactions						
Membership * 1890			1.680	0.500	2.645	0.093
Membership * 1900	2.814	0.140	0.929	0.860	1.702	0.094
Membership * 1910 (ref.)	1.000		1.000		1.000	
Membership * 1920	1.062	0.780	1.576	0.300	1.277	0.500
Membership * 1930	0.979	0.920	1.583	0.380	1.670	0.190
Membership * 1940	0.818	0.420	2.043	0.320	2.185	0.170
Summary statistics						
N members	652		45		76	
N controls	1,956		135		228	
N observations	6,648		556		1,049	
Events	4,294		405		769	
P-value	0.000		0.000		0.000	
SD of couple-level random effect	2.468		3.298		2.238	

Note: Hazard ratios (HR) and P-values from mixed-effects Cox proportional hazard regressions.

Table 15   *Effect of voluntary organisation participation before partnering on the probability of another birth as Hazard ratios from a mixed effects Cox proportional hazard regression*

Variable	HR	Standard error	P-value
Husband a union member	0.773	0.054	0.000
Husband a temperance member	0.851	0.092	0.079
Wife a temperance member	0.925	0.107	0.470
Socioeconomic status			
Farmer	1.000		
Farm worker	0.875	0.037	0.000
Middle class	0.820	0.030	0.000
Skilled worker	0.794	0.027	0.000
Unskilled worker	0.888	0.016	0.000
Husband a migrant	0.912	0.020	0.000
Wife a migrant	0.972	0.018	0.120
Log of net fertility	1.018	0.039	0.660
Wife's age squared	0.999	0.000	0.000
Union present in neighbourhood	0.840	0.018	0.000
Temperance organisation present in neighbourhood	0.965	0.016	0.030
Parish			
Skellefteå rural (ref.)	1.000		
Skellefteå town	1.061	0.047	0.210
Byske	0.963	0.023	0.110
Bureå	1.412	0.047	0.000
Norsjö	1.062	0.028	0.033
Jörn	1.202	0.032	0.000
Proportion migrants	0.891	0.010	0.000
Log of population density	0.968	0.007	0.000
Decade			
1880	0.988	0.023	0.610
1890	0.998	0.019	0.910
1900 (ref.)	1.000		
1910	0.953	0.018	0.009
1920	0.708	0.022	0.000
1930	0.448	0.026	0.000
1940	0.592	0.030	0.000
Summary statistics			
N observations	104,345		
N events	50,578		
Degrees of freedom	27		
Log-likelihood	-402,823		
P-value	0.000		
N unique couples	17,751		
SD of couple-level random effect	2.147		

APPENDIX B

The six parishes in the Skellefteå region were partitioned into smaller sub-areas. The procedure was started by partitioning the geographical space of a parish by calculating the Voronoi tessellation based upon the coordinates of a place of residence. The tessellation algorithm assigns each point within the geographical space of the parish to a place of residence which it is closest to (Lee & Schachter, 1980). This results in a partitioning of the parish into N smaller areas, where N is equal to the number of unique places of residence within the parish, see graph A in Figure 11.

The next step of the procedure was to cluster the places of residence into larger groups of locations which are close to each other. The number of clusters was dependent on the average yearly population in a parish, between 1880 and 1949. In the parish with the highest population density, Skellefteå town, the ratio of clusters is 4/1000 people, and in the other parishes, it is 15/1000. Each place of residence was allocated into a sub-region through K-means clustering, which maximises the geographical distance between groups while minimising the distance within each group, see graph B in Figure 11.

The final step was to combine each area created by the Voronoi tessellation according to its cluster assignment, into one sub-region, see graph C in Figure 11. The process results in a spatial partition of the region that better reflects the population dispersion and differences in population density than parishes or places of residence. The summary statistics of a neighbourhood is compared to parishes in Table 16.

Figure 11   *Spatial partioning procedure for Bureå parish, based on unique locations within the region from 1880 to 1949*
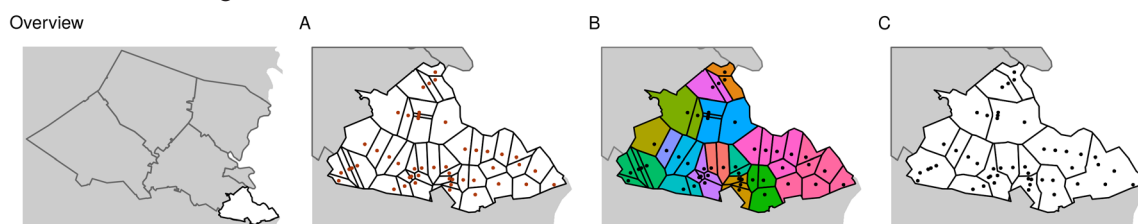

Table 16   *Descriptive statistics of geographical features in the Skellefteå region 1880-1949*

Entity	N	Area in km²			
		Mean	Median	Min	Max
Neigbourhood	148	44.6	29.8	3.8	174.1
Parish	6	1099.2	1232.2	107.4	1935.4
Place	1119				