



## Article

# Uptake of Childcare Arrangements—Grandparental Availability and Availability of Formal Childcare

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**Abstract:** Grandparents constitute an important source of childcare to many parents. Focusing on the Belgian context, this paper improves our understanding of childcare decision-making by investigating how formal childcare availability and availability of grandparents affect childcare arrangements. By means of multinomial regression models we simultaneously model uptake of formal and informal childcare by parents. Combining linked microdata from the Belgian censuses with contextual data on childcare at the level of municipalities, we consider formal childcare availability at a local level, while including a wide array of characteristics which may affect grandparental availability. Results indicate that increasing formal care crowds-out informal care as the sole care arrangement, whereas combined use of formal and informal care becomes more prevalent. Characteristics indicating a lack of grandmaternal availability increase uptake of formal care and inhibit to a lesser extent the uptake of combined formal and informal care. While increasing formal care substitutes informal care use, the lack of availability of informal care by grandparents may be problematic, particularly for those families most prone to use informal care.



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**Keywords:** formal childcare; informal childcare; grandparents; childcare availability

## 1. Introduction

Research into grandparental childcare provision has recently gained more academic interest in Europe. Grandparents are the most important source of informal childcare (Fergusson et al. 2008; Ghysels and Van Vlasselaer 2007), and despite variations in the frequency and intensity of care, grandparents have proven to be a non-redundant source of help to parents with young children across European countries (Fergusson et al. 2008; Hank and Buber 2009; Igel and Szydlik 2011). Grandparents, especially grandmothers, often express a sense of responsibility to help their adult children combine work and family life (Horsfall and Dempsey 2015; Villar et al. 2012).

Given past demographic trends and current policy changes, concern is rising that the availability and willingness of grandparents to provide informal childcare may decline significantly in the near future (Aassve et al. 2012a; Arpino et al. 2014; Gray 2005; Koslowski 2009; Lewis et al. 2008). The generations currently on the verge of entering retirement have been among the first to benefit from the rapid expansion of education in the second part of the 20th century, and this generation of women increasingly participated in the labor market. Meanwhile declining marriage rates, postponement of family formation and rising divorce rates affected their household structures and kin networks. The provision of childcare by grandparents is related to a number of these characteristics, such as employment status, health status, marital status as well as the physical distance to grandchildren (Hank and Buber 2009; Ho 2015; Igel and Szydlik 2011). More recently, the increase in legal retirement ages, and labor force participation in older age groups (European Commission 2002), may give additional conflict with their role as informal caregivers.

While the changing characteristics of grandparents seem to imply that the potential for family support with childcare may become less available, formal childcare has become

increasingly accessible to parents in most European countries. It is, therefore, expected that parents may have less need for informal care and alternatively use formal childcare services, suggesting that formal care will crowd-out informal care use. Nevertheless, the availability of formal childcare in most countries does not cover demand (European Commission 2014), and formal childcare use is characterized by strong socio-economic differentials in most countries (Van Lancker and Ghysels 2016). Even when formal care is affordable, as is the case in Belgium, informal childcare may continue to be an important source of childcare for families with limited access to formal childcare, particularly when local availability of formal care is limited and long waiting lists are in place. Moreover, informal care is often an attractive childcare arrangement since it is more flexible and usually comes at no cost. The objective of this paper therefore is to investigate how the uptake of formal and informal childcare, and combinations thereof, is conditioned by the local availability of formal childcare as well as the availability of informal care providers. This will improve our understanding of the effect of grandparental availability on childcare arrangements and whether informal care is substituted by formal care.

The current literature provides a limited understanding of the interplay of between formal and informal childcare availability and uptake of childcare by parents. Whereas the uptake of formal childcare in relation to its cost, quality and availability (Abrassart and Bonoli 2015; Blau and Currie 2006), and the uptake of informal childcare in relation to the characteristics of informal childcare providers (Di Gessa et al. 2016; Hank and Buber 2009; Igel and Szydlik 2011) or the characteristics of families using informal care (Fergusson et al. 2008) have received substantial attention, they have typically not been studied together. Research in the US and Australia indicates that a combination of different childcare arrangements—formal and informal—is often made (Bowes et al. 2004; Morrissey 2008; Neilsen-Hewett et al. 2014). Evidence on European contexts is more limited (Roder et al. 2018; Verhoef et al. 2016).

This paper contributes to the existing literature on uptake of (in)formal childcare in three ways. First, we investigate how grandparental availability affects formal childcare uptake and how local access to formal care affects informal care uptake. This allows us to answer the question whether formal childcare substitutes for informal care or whether parents combine formal with informal care arrangements. To date, cross-national research on uptake of informal childcare has only considered its relation to public childcare expenditure or formal childcare enrolment at the national level as indicators of access to formal care (Di Gessa et al. 2016; Igel and Szydlik 2011). Contrary to expectations, higher formal childcare expenditure did not seem to crowd-out informal care use, although intensive informal care did become less prevalent. National-level indicators are crude measures, however, of the availability of formal childcare to parents as they conceal substantive regional variation of childcare availability within countries (Bunning 2017; Del Boca et al. 2005; Wood and Neels 2019). As a result, previous studies have not considered availability of formal and informal childcare from the parents' perspective, nor have uptake of formal and informal childcare been modelled simultaneously. Consequently, we hitherto do not understand whether improved access to formal care can substitute for informal care use or increases combined use of formal and informal care.

As a second contribution, we address the question whether limited local access to formal childcare makes grandparents more responsive to parents' needs, or whether informal caregiving is mostly determined by grandparents' availability regardless of local availability of formal care to parents. It is relevant to know whether parents in regions with little formal care availability get help from grandparents and how this is related to grandparents' characteristics, particularly considering the imminent demographic changes in the profile of grandparents and policy changes with respect to retirement.

Third, we investigate whether the associations between childcare arrangements and the characteristics of formal and informal care providers vary in terms of parents' socio-economic position. Uptake of formal childcare is often characterized by strong socio-economic differentials (Van Lancker and Ghysels 2016) and parents who do not use formal

care are assumed to use informal care, unless they provide care themselves. However, research on informal childcare availability is often investigated from the grandparents' perspective (Hank and Buber 2009; Igel and Szydlík 2011; Luo et al. 2012), and as a result, information on formal care available to parents is usually lacking, as well as the actual uptake of formal care arrangements. It is, therefore, unclear whether and to what extent socio-economic differentials in access to formal care are mitigated by informal care providers or whether these families have no access to childcare and provide care for children themselves.

Belgium presents an interesting context, since it belongs to the forerunner countries alongside France and the Scandinavian countries with respect to formal childcare coverage for 0–3 year-olds early on (Population Council 2006), but considerable variation in childcare access prevails at the local level (Wood and Neels 2019). In addition, Belgium also has a high frequency of grandparental childcare, with levels of weekly childcare provision comparable to some Southern European countries (Igel and Szydlík 2011). Characteristic of the Belgian context is the availability of linked microdata from the Belgian censuses that provide us with unique and detailed information on both parents and grandparents, and which have been combined for this study with municipality-level data on formal childcare coverage. The combined use of microdata from the Belgian censuses with contextual data at the municipality level allows us to jointly consider formal childcare availability at the local level, while including a wide array of characteristics that may affect grandparents' ability to provide informal childcare.

## 2. Literature Review

### 2.1. Factors Driving Childcare Strategies

Because grandparental childcare can be understood as a form of intergenerational solidarity (Bengtson and Roberts 1991), we resort to the theoretical framework developed by Szydlík (2012), which identifies the main mechanisms influencing intergenerational solidarity. Foremost, the demand for informal childcare will depend on the characteristics of the parents, such as their employment status and income potential, educational level, number and age of their children, as well as their local access to formal childcare. The decision of grandparents to engage in childcare in turn depends on their opportunity structures to provide care. As a result, we need to study how the opportunity structures of grandparents interact with the needs of the parents. This interaction takes place within the broader family structure and cultural context. The broader family structure refers to family size and composition, as well as family roles, such as the role of grandparent and norms and expectations towards grandparents. The cultural context refers to the welfare state and the labor market, such as female and (grand)maternal labor market participation and availability of part-time jobs, and family policies aimed at the reconciliation of work and family such as parental leave but also the amount of public provision of childcare. The availability of formal childcare is a contextual feature that is likely to substantially determine parents' need for informal childcare. Considering this framework, the (combined) uptake of formal and informal childcare arrangements depends on supply-side characteristics of both formal and informal care providers that jointly determine the availability of care, together with the demand for childcare by parents.

### 2.2. Demand for Childcare by Parents

Increasing and prolonged enrolment in education among women and rising levels of female labor market participation before and after family formation have made the outsourcing of childcare indispensable, unless extended periods of maternal and parental leave allow parents to organize care within the household (Blossfeld and Drobníč 2001; Erhel and Guergoat-Larivière 2013). If parents, particularly mothers, want to combine work and parenthood, they typically rely on formal and/or informal childcare. While formal care is paid care and organized and supervised by professional childminders, informal care

is usually provided by grandparents, although it can also include other family members, neighbors or friends (Fergusson et al. 2008; Ghysels and Van Vlasselaer 2007).

The uptake of formal childcare has been associated with strong positive income and educational gradients in both Belgium (Ghysels and Van Lancker 2009) and other European countries (Matsaganis and Verbist 2008; Neels and Theunynck 2012; Pavolini and Van Lancker 2018; Van Lancker and Ghysels 2016). These gradients may reflect differential demand due to variation in overall labor market participation and employment intensity, since informal care is deemed less compatible with fulltime employment (Van Lancker and Horemans 2017). As a result, socio-economic gradients in uptake of formal care may partially reflect different needs on behalf of the households considered. Another potential explanation is that differential cultural norms or preferences regarding specific care types may entail differential uptake (Vincent et al. 2010). Finally, socio-economic differentials in uptake of formal care have also been related to an insufficient supply of, and structural constraints in the access to formal childcare, such as affordability (Abrassart and Bonoli 2015; Pavolini and Van Lancker 2018) and opening hours (Bihan and Martin 2004). Policies prioritizing dual-earners are likely to strengthen these differentials (MAS 2007). Socio-economic gradients are found to be less strong when publicly and subsidized childcare is widely available, or when legal entitlement to childcare exists or costs for low-income families are lower (Van Lancker and Ghysels 2016).

The demand for informal childcare has been associated with a lack of access to formal care, due to a lack of local access within the neighborhood or the existence of waiting lists which prevent parents from gaining access in time, making them resort to temporary, usually informal arrangements (Chaudry 2004; MAS 2007). Previous research also indicated that lower educated mothers with lower family incomes are more likely to make trade-offs for practical, mostly financial reasons (Rose and Elicker 2008). Parents with non-standard working hours are more likely to call upon grandparents because of a mismatch between the availability and opening hours of formal childcare arrangements with the work schedules of parents (Morrissey 2008; Vandell et al. 2003). As a consequence, parents may make use of multiple arrangements, both formal and informal, during a typical week (Morrissey 2008). When trust and knowledge of formal childcare is lacking, parents are more likely to rely on the grandparents (Chaudry 2004; Wheelock and Jones 2002). Informal care has been shown to be an important source of care to mothers with a lower socio-economic status in the UK (Fergusson et al. 2008; Gray 2005) and has a positive influence on maternal employment in Italy, particularly among lower educated mothers with young children (Arpino et al. 2014). However, the latter found indications of regional variation in these effects which were likely to be related to regional variation in formal childcare availability and local labor market conditions, which were not explicitly controlled for.

At a cross-national level, no relation was found between inequality in formal childcare use and informal care uptake, which seemed to imply that there was no substitution between the two types of care arrangements (Van Lancker and Ghysels 2016). In Belgium, positive socioeconomic differentials in the uptake of informal care were found by income deciles, although differential uptake of formal care was not accounted for (Ghysels and Van Lancker 2009). Moreover, unequal access to informal care has rarely been considered, except for limited evidence from a study by Ghysels et al. who found some indications that availability of grandparents in Belgium as potential care providers is lower to families in lower income quintiles (Ghysels and Debacker 2007; Ghysels and Van Lancker 2009).

### 2.3. Determinants of Grandparental Availability for Childcare

#### 2.3.1. Family Structure

Family structure is one of the contextual factors influencing the potential for intergenerational solidarity, such as childcare. Recently, substantial changes have taken place that may positively impact the potential for grandparental care. Nowadays grandparents are supposedly more available because demographic changes in both mortality and fertility prolonged the duration of shared lives between grandchildren and grandparents and



resulted in a larger number of surviving grandparents (Hagestad 2006; Uhlenberg 2004). Additionally, grandparents are more likely to be in good health and thus more available to provide childcare (Igel and Szydlik 2011). Compared to previous decades, and as a consequence of declining fertility, families have become smaller with less grandchildren potentially competing for care. Research indicates that the firstborn or only grandchild is more likely to receive grandparental care (Fergusson et al. 2008; Jappens and Van Bavel 2012), and that having more grandchildren decreases grandparental involvement in care, likely because it is too demanding to care of several children (Douglas and Ferguson 2003; Gattai and Musatti 1999). Social and cultural roles for grandparents have changed, with a stronger emphasis on affectual and emotional close bonds (Uhlenberg 2004), which may positively affect grandparental willingness to be involved in their grandchildren's lives.

However, there are also some potentially counteracting changes that have taken place. The postponement of fertility in both grandparental and parental generations, influenced the length of grandparenthood to a large extent. This affects at which life stage in the life course persons become grandparents (Uhlenberg 2004), and older grandparents are less likely to provide childcare (Igel and Szydlik 2011; Luo et al. 2012). Moreover, postponement of childbearing is highly stratified by socio-economic position and grandparents in higher educated households are on average older compared to the lower educated households (Skopek and Leopold 2017). Additionally, people around the age of 60 are increasingly likely to have a living parent in need of care which could cause additional role conflict (Murphy et al. 2006; Noble et al. 2012). It remains unclear how prevalent this double care burden is, with the exception of a study in Germany which indicated that this "sandwich generation" seems rare, especially in combination with actual labor force participation (Künemund 2006). Changes in living arrangements, such as the loss of a partner or divorce, are another factor that could counteract the potential for care. Lastly, while grandparents value involvement and the affectual bond with grandchildren, they may also find childcaring too intense, not consider childcare their responsibility or value other activities (Gattai and Musatti 1999; Horsfall and Dempsey 2015).

### 2.3.2. Gender, Kinship and Marital Status

Research consistently reports that the maternal grandmother is generally more involved in childcare (Danielsbacka et al. 2011; Hank and Buber 2009; Igel and Szydlik 2011). This is possibly because mothers are generally still in charge of organizing childcare and they may be more inclined to call upon their own parents (Wheelock and Jones 2002). Grandfathers are generally less likely to provide care, or they get involved when grandmothers are providing care (Guzman 2004; Hank and Buber 2009; Horsfall and Dempsey 2015). Grandfathers are more likely to engage in recreational activities (Horsfall and Dempsey 2015). Divorced grandfathers are least likely to provide childcare, whereas married grandparents provide childcare more often (Ho 2015). Having a partner thus seems to act as a resource (Igel and Szydlik 2011; Luo et al. 2012).

### 2.3.3. Education and Employment Status

Grandparents who have sufficient financial resources are less affected by the expenses that are made when caring for children (Guzman 2004) and are more likely to provide both occasional and regular care (Albertini et al. 2007; Igel and Szydlik 2011). Higher educated grandparents are more often engaged in informal childcare provision than lower educated grandparents but education did not affect intensity (Igel and Szydlik 2011).

In countries with higher labor force participation among women aged 55–64, the occurrence of grandparental care is lower (Di Gessa et al. 2016; Lewis et al. 2008). At the individual level, research on the effect of grandparental employment status is inconclusive. Some research confirms the expectation that employed grandparents are less likely to provide childcare (Aassve et al. 2012b; Hank and Buber 2009; Luo et al. 2012), but others did not (Silverstein and Marengo 2001). In Europe, employment status did not affect general childcare provision but it did influence intensity of care as employed grandparents

were less likely to provide intensive care (Hank and Buber 2009). In Australia it was found that employed grandparents were more likely to provide childcare, while retirement was associated with more intensive caregiving (Horsfall and Dempsey 2015). These results suggest that grandparents are able to engage in childcare despite being employed. Lakomý and Kreidl (2015) argue that a distinction between part-time and full-time employment needs to be made and that it is important to consider gender and kinship. They found that grandfathers' employment status was not significantly related to their tendency to provide childcare. For grandmothers, it was important to consider employment intensity and kinship. Paternal grandmothers who are part-time employed are as likely to provide childcare as non-employed paternal grandmothers, while full-time employment prevented them from providing frequent care. Maternal grandmothers seemed to provide care irrespective of employment intensity. Overall, unemployed grandparents were not more likely to provide childcare than full-time working grandparents.

#### 2.3.4. Distance

Another determinant of grandparental availability to provide childcare is distance. The provision of informal childcare by grandparents is most likely when they are living within the same household or building, or when the distance is shorter than 5 km (Ho 2015; Igel and Szydlik 2011; Vandell et al. 2003).

#### 2.4. Formal Childcare Availability

The uptake of formal and informal childcare by parents has rarely been studied simultaneously, but some studies control for national childcare coverage when investigating grandparental childcare use (Di Gessa et al. 2016; Jappens and Van Bavel 2012). Surprisingly, a high public childcare expenditure does not necessarily "crowd out" informal family solidarity (Igel and Szydlik 2011). Grandparents in countries with high levels of formal childcare are even more often involved in caring for their grandchildren than in countries with low levels of formal childcare. In the latter, however, grandparents more often provide intensive childcare. In countries with a high provision of formal childcare, grandparents are less likely to be the main source of childcare (Jappens and Van Bavel 2012). However, these studies did not take local access to formal childcare into account and given the indications of spatial inequality to access, this seems an important aspect to consider. While these studies could not take parental access to and uptake of formal care into account, it is possible that grandparental childcare becomes more complementary to formal childcare as the latter becomes more widely available.

### 3. Hypotheses

Parents need to organize childcare and make a decision considering the availability of alternative arrangements. We will differentiate between (i) not having a care arrangement (care being organized within the household), (ii) using only a formal childcare arrangement, (iii) using only informal care (presumably grandparental care), or (iv) using a combination of formal and informal childcare. While the choice between these options will depend on the needs and preferences of parents, it will also depend on the availability and characteristics of the different childcare options. The availability of informal care is expected to affect the uptake of formal care arrangements and vice versa. Although overall formal childcare use is the most prevalent type of care in Belgium (Ghysels and Debacker 2007; Vande Gaer et al. 2013), uptake will depend on local availability.

#### 3.1. The Availability of Formal and Informal Childcare

**Hypothesis 1a (H1a).** *We expect that a higher availability of formal childcare within the municipality is associated with a lower probability that parents will rely exclusively on informal childcare, and thus will crowd-out reliance on informal care only. In addition, we assume that grandparental care becomes more complementary to formal childcare as coverage increases, and that it will require less intensive care on the part of the grandparents.*

**Hypothesis 1b (H1b).** *We therefore expect that the combination of formal and informal care becomes more prevalent as availability of the former increases.*

Additionally,

**Hypothesis 1c (H1c).** *We expect parents to be more likely to rely exclusively on formal childcare rather than informal care, when grandmothers are less available: we expect grandmothers to be less available for childcare when they are employed, have no partner to support them with childcare tasks, have worse self-rated health, are older or live further away, and have more grandchildren who potentially compete for care.*

However,

**Hypothesis 1d (H1d).** *Compared to the choice between formal versus informal care use, we expect the characteristics of the informal care providers to be less important to determine the choice between formal and combined formal and informal care, as grandmothers may still be available and willing to provide less intensive supplementary care.*

### 3.2. Variation in Grandmaternal Involvement Depending on Local Childcare Availability

We expect that characteristics of grandmothers will be of varying importance depending on the level of formal childcare available in the municipality where the parents live. In a context of overall low availability of formal childcare, we assume that there will be a higher need for grandmaternal childcare and the lack of access to formal childcare may encourage grandmothers to engage in childcare despite their own limited availability.

**Hypothesis 2 (H2).** *This means that characteristics indicating grandmaternal availability may be less important in setting with limited formal childcare compared to settings with high availability.*

### 3.3. Variation in Grandmaternal Involvement Depending on Mothers' Employment Opportunities

We expect a differential effect of grandmaternal availability depending on the type of employment opportunities available to mothers. We expect that mothers with favorable employment opportunities will predominantly use formal childcare or combine formal and informal care, as they have an intensive care demand. Mothers with favorable employment opportunities are less likely to have precarious employment positions, and more likely to have predictable and standard working hours, which are easier to combine with formal care. In such cases, it will predominantly depend on grandparents whether supplementary informal care is provided. As a result,

**Hypothesis 3a (H3a).** *We expect characteristics pertaining to grandmothers' availability to largely determine the choice between formal care use or combined formal and informal care among mothers with high employment probabilities.*

In contrast, mothers with low employment opportunities may be more likely to rely completely on informal care for multiple reasons, including flexibility and affordability, but also the lack of access to formal childcare.

**Hypothesis 3b (H3b).** *We, therefore, expect that availability of the grandmother in these cases will largely discriminate between having no care arrangement or using informal care only.*

## 4. Data and Methods

We used data from the 2001 Belgian census, which covers the entire population legally residing in Belgium on 1 October 2001. Apart from the socio-economic situation of the Belgian population, the census questionnaire inquired about the regular childcare arrangement of households with a co-resident child born after 1 January 1996. We selected families with one child aged between three months and two and a half years: these are the

ages where childcare is most needed because there is only a limited amount of maternal leave available and enrolment in preschool only takes place after this age. Additionally we selected two-parent households, since it is unclear to what extent children are still cared for by the other parent when parents are separated. We were unable to identify same-sex couples and they were therefore not included. In the census form, parents indicated the number of children in the household attending crèche or family care, or being cared for by other household members or by family or acquaintances.

For the analysis of childcare arrangements we consider care by family members or acquaintances as informal care use. If no care arrangement or other household members were indicated, childcare is assumed to be arranged within the household (no childcare arrangement). Both childcare in a crèche or family-based care (childminders) are considered formal childcare. We combined the information on childcare arrangements into a dependent variable distinguishing four categories, (1) no care use, (2) informal care use only (3) formal care use only and (4) combined formal and informal care use.

#### *4.1. Main Explanatory Variables*

##### *4.1.1. Local Availability of Formal Childcare*

We included local childcare coverage data provided by the regional agencies supervising childcare “Kind and Gezin” (covering Flanders and Brussels) and “l’Office de la Naissance et de l’Enfance” (covering Wallonia and Brussels). The data allowed us to include information on availability of formal childcare arrangements at the municipality level, which was measured as the number of places available per 100 children between the ages of 0 and 3. On average, there were 26 places available per 100 children in Belgium in this age category in 2001. In addition to availability of childcare at the municipality level, we had information on households’ satisfaction with the local provision of formal childcare in their neighborhood. This variable distinguished between three categories, (1) bad, (2) normal and (3) very well.

##### *4.1.2. Availability of the Grandmother*

We included information on the maternal grandmother since previous research indicated that they are the most important informal care givers ([Danielsbacka et al. 2011](#); [Hank and Buber 2009](#); [Wheelock and Jones 2002](#)). Grandparents were identified by linking the 2001 Belgian census to the census of 1991. This linkage allowed us to identify grandparents if the mothers in our selection were still living in their parental home in 1991, but moved out of the parental household and set up an independent household with children of their own between 1991 and 2001. This strategy allows for a unique census-based multi-actor dataset with detailed information on household composition, socio-demographic profile, socio-economic characteristics and proximity for of all the members of the wider kin network.

First, the analyses included a variable indicating whether we were able to identify both maternal grandparents, only the grandmother or none of the grandparents. Second, we included a number of socio-demographic characteristics on the grandmother, such as age of the grandmother and her marital status, which differentiates between (1) married, (2) widowed (3) divorced and (4) other. We also included indicators of the employment status of the maternal grandmother, distinguishing between (1) employed or (2) inactive and unemployed, as well as an indicator of educational level distinguishing three categories: (1) no, primary or lower secondary education, (2) higher secondary education or (3) higher education and higher academic education. Third, we included two indicators on competing care demands. We included the number of live births to the grandmother, indicating the number of siblings that may potentially compete for care. In addition, we included a dummy variable reflecting whether the grandmother provided care to one or more persons with chronic illness, condition or handicaps, and this at least once a week. Fourth, we included a number of indicators reflecting the health status of the grandmother. Self-rated health distinguishes between (1) healthy (average, good or very good self-rated health) and



(2) unhealthy (poor to very poor self-rated health). We also included a dummy variable reflecting whether the maternal grandmother is limited in her daily activities as a result of a long-standing illness or disability. Fifth and finally, we included a measure of the distance between the place of residence of the parents and the maternal grandparent. Since the statistical sector (a subunit of municipality) of the place of residence is registered in the 2001 census, we included the Euclidian distance in kilometers between the centroids of the statistical sectors where parents and the maternal grandparent reside. When parents and grandparents lived within the same statistical sector, but not the same household, we included the radius of the statistical sector.

#### 4.1.3. Maternal Employment

There is substantial evidence that maternal employment is affected by childbearing, while there is no evidence of a negative ‘child-penalty’ for fathers (Maes et al. 2021; Kil et al. 2018; Uunk et al. 2005). Without access to childcare, continued employment after childbearing is very difficult for mothers. This means that maternal employment is dependent on childcare access and that measurements of maternal employment and care use at a single point in time are mutually endogenous. Rather than using the observed employment position at the time of the 2001 census, the analyses therefore included estimated employment probabilities reflecting the employment opportunities available to mothers. Using logistic regression, employment probabilities were estimated for a subset of women who do not have children (yet), but who have the same profile based on (1) age (linear and squared effects), (2) a detailed measurement of educational level distinguishing 19 categories (18 dummies), (3) nationality (eight categories, distinguishing between (i) Belgians, migrants from (ii) the neighboring countries of Belgium, (iii) Southern-Europe, (iv) Eastern-Europe, (v) other-EU, (vi) Morocco, (vii) Turkey and (viii) other non-EU), (4) generation (first versus second generation) and (5) marital status (married or unmarried). Additionally, we controlled for (6) municipality (588 dummies representing 589 municipalities) which is used as a proxy of local labor market conditions. As previous research (Neels and Reinhard 2001) indicated that the returns of educational level vary by migration background (origin and generation), and on the household position in combination with migration background, we included two-way and three-way interactions between education, nationality and generation, as well as two- and three-way interactions between nationality, generation and marital status. The employment probabilities estimated for this subset of childless women were subsequently assigned to the mothers in our dataset having the same characteristics to have an indication of their employment potential without access to childcare being a confounding factor. By using estimated employment probabilities we can distinguish between mothers with low or high labor market opportunities, which has repeatedly been shown to affect the demand for childcare. We estimated three indicators, distinguishing (1) the overall probability of being employed versus the probability of being unemployed or inactive, (2) the probability of being in fulltime employment, and (3) the probability of being in a flexible work arrangement. Fulltime employment is defined as working at least 38 hours a week. Flexible employment is defined as flexibility on the part of the employee, such as temporary employment, irregular hours or working in shifts, which are work arrangements that are less compatible with formal childcare use. The employment indicators were estimated as shown in Equations (1)–(3).

$$\hat{p}(\text{work}) = \frac{e^{\alpha + \beta A + \beta A^2 + \sum \beta E + \sum \beta M + \sum \beta N + \sum \beta G + \sum \beta L + \sum \beta N.G + \sum \beta E.N + \sum \beta E.G + \sum \beta E.N.G + \sum \beta L.N + \sum \beta L.G + \sum \beta L.N.G}}{1 + e^{\alpha + \beta A + \beta A^2 + \sum \beta E + \sum \beta M + \sum \beta N + \sum \beta G + \sum \beta L + \sum \beta N.G + \sum \beta E.N + \sum \beta E.G + \sum \beta E.N.G + \sum \beta L.N + \sum \beta L.G + \sum \beta L.N.G}} \quad (1)$$

$$\hat{p}(\text{ftwork}) = \frac{e^{\alpha + \beta A + \beta A^2 + \sum \beta E + \sum \beta M + \sum \beta N + \sum \beta G + \sum \beta L + \sum \beta N.G + \sum \beta E.N + \sum \beta E.G + \sum \beta E.N.G + \sum \beta L.N + \sum \beta L.G + \sum \beta L.N.G}}{1 + e^{\alpha + \beta A + \beta A^2 + \sum \beta E + \sum \beta M + \sum \beta N + \sum \beta G + \sum \beta L + \sum \beta N.G + \sum \beta E.N + \sum \beta E.G + \sum \beta E.N.G + \sum \beta L.N + \sum \beta L.G + \sum \beta L.N.G}} \quad (2)$$

$$\hat{p}(\text{flexwork}) = \frac{e^{\alpha + \beta A + \beta A^2 + \sum \beta E + \sum \beta M + \sum \beta N + \sum \beta G + \sum \beta L + \sum \beta N.G + \sum \beta E.N + \sum \beta E.G + \sum \beta E.N.G + \sum \beta L.N + \sum \beta L.G + \sum \beta L.N.G}}{1 + e^{\alpha + \beta A + \beta A^2 + \sum \beta E + \sum \beta M + \sum \beta N + \sum \beta G + \sum \beta L + \sum \beta N.G + \sum \beta E.N + \sum \beta E.G + \sum \beta E.N.G + \sum \beta L.N + \sum \beta L.G + \sum \beta L.N.G}} \quad (3)$$

where A = age, E = education, M = municipality, N= nationality, G= generation and L = marital status.

#### 4.2. Control Variables

We control for a number of socio-demographic characteristics that previous research on childcare indicated to be relevant. First, we controlled for country of origin and generation by including a variable distinguishing between (1) natives and (2) second generation migrants. First generation migrants were excluded since they are less likely to have access to grandparents. We additionally controlled for the age of the mother at the birth of her first birth, the age of the child and the number of adults in the household as an indication of potential care supply within the household, where we differentiated between three categories: (1) two adults, (2) three adults or (3) four or more co-resident adults in the household. For marital status, we distinguished between (1) married and (2) cohabiting parents. We also controlled for the educational level of both parents, each time we distinguished four categories, (1) no or primary education and lower secondary education, (2) higher secondary education, (3) higher education and (4) higher academic education (master degree or PhD). We included employment status of the father in four categories (1) employed or (2) in education (3) unemployed and (4) inactive. For the mother we included the estimated indicators of employment potential as continuous control variables: (1) the estimated probability of employment, (2) the estimated probability of fulltime employment, and (3) the estimated probability of having a flexible working arrangement.

#### 4.3. Descriptives

In Table 1 we describe the characteristics of the households by care arrangement. We observe that households without a care arrangement are predominantly lower educated mothers and fathers while the opposite is true for formal care users. Households relying solely on informal care have a substantial share of lower educated mothers, but also higher educated mothers, yet few mothers with a higher academic degree. There is no clear pattern with respect to paternal employment except that households with no care arrangement more often have an unemployed or inactive father. Mothers using formal care only are on average one to almost two years older when giving birth for the first time compared to mothers using other care arrangements. Mothers with no care arrangement clearly have poorer employment prospects than those using care: they have a lower estimated overall employment probability, lower fulltime employment probability and higher chance of working in flexible employment. While having somewhat better employment probabilities than mothers using no care, mothers making use of informal care also have worse employment opportunities than mothers using formal care or combined care. Mothers with no care arrangement and to a lesser extent those using only informal care live in municipalities with a lower average childcare coverage, which is also reflected by their lower overall satisfaction with the local provision of childcare.

When considering the characteristics of the grandmother, we observe that households with no care arrangement are more frequently households where we were unable to identify any grandparents, the same is true for formal care users. Families using formal care or combined care more often have a grandmother who is employed and higher educated. Mothers with no care arrangement are also more likely to have more siblings, a grandmother that is on average younger or has lower self-rated health. Families with no care arrangement, as well as those only using formal care live on average further away from their maternal grandparent.

**Table 1.** Descriptives: characteristics by childcare arrangement, two-parent households with one child, born between 1 May 1999 and 1 July 2001, Belgium, 2001.

	No Care	Formal Care	Informal Care	Both	Total
N	15,969	31,654	21,088	6515	75,226
<i>Parental Characteristics</i>					
<b>Migration background</b>					
Native	77.93	91.15	85.36	91.49	87.11
second generation	22.07	8.85	14.64	8.51	12.89
<b>Maternal education</b>					
Primary, secondary	29.87	7.48	15.44	7.92	14.5
Higher secondary	43.31	25.68	43.81	32.31	35.08
Higher education	20.15	42.44	34.09	44.62	35.55
Higher academic	6.68	24.40	6.67	15.15	14.86
<b>Paternal education</b>					
Primary, secondary	35.81	14.61	25.20	15.85	22.18
Higher secondary	37.85	31.53	46.45	40.14	37.8
Higher education	15.54	26.92	19.94	27.87	22.64
Higher academic	10.80	26.94	8.41	16.13	17.39
<b>Paternal employment</b>					
Employed	83.92	96.86	94.55	97.36	93.53
Education	0.31	0.14	0.10	0.11	0.16
Unemployed	12.18	2.51	4.51	2.24	5.09
Inactive	3.59	0.49	0.83	0.29	1.22
<b>Marital status</b>					
Married	74.88	74.05	72.07	73.66	73.64
Cohabiting	25.12	25.95	27.93	26.34	26.36
<b>Number of adults in the household</b>					
2 adults	96.95	98.52	98.08	98.86	98.09
3 adults	2.40	1.25	1.6	0.95	1.57
4 or more	0.64	0.23	0.32	0.18	0.34
Age Child (mean)	0.90	1.05	1.03	1.06	1.01
Age 1st birth (mean)	27.04	28.99	27.25	27.98	28.00
<b>Estimated employment mother</b>					
Employment (mean)	68.41	88.77	82.42	88.52	82.64
Fulltime work (mean)	54.65	67.90	60.43	66.46	62.87
Flexible work (mean)	42.71	32.64	38.74	34.39	36.64
<b>Local childcare</b>					
Coverage (mean)	21.96	26.73	23.18	26.68	24.72
<b>Satisfaction local provision childcare</b>					
Bad	27.26	23.96	26.69	23.14	25.32
Normal	57.18	52.14	59.61	54.19	55.43
Very well	15.56	23.90	13.70	22.67	19.25
<i>Grandmother Characteristics</i>					
<b>Maternal grandparents known</b>					
None	34.60	20.95	15.96	13.20	21.78
Both	48.58	60.90	67.20	70.13	60.85
Grandmother only	13.28	14.04	13.94	13.49	13.8
Grandfather only	3.54	4.11	2.91	3.18	3.57
<b>Marital status</b>					
Married	79.29	81.13	83.20	84.10	81.73
Widow	9.12	8.51	8.29	6.99	8.4
Divorced	11.11	10.10	8.20	8.72	9.56
Other	0.49	0.27	0.31	0.18	0.31
<b>Employment status</b>					
Inactive	74.34	63.32	75.60	65.88	69.25
Employed	25.66	36.68	24.40	34.12	30.75

Table 1. Cont.

	No Care	Formal Care	Informal Care	Both	Total
<b>Educational level</b>					
Primary, secondary	69.04	50.21	70.01	57.41	59.78
Higher secondary	19.53	23.33	20.28	24.00	21.9
Higher education	11.43	26.46	9.71	18.59	18.33
<b>Live births (mean)</b>	3.38	2.80	2.79	2.60	2.88
<b>Weekly care provision</b>					
No	85.66	83.01	84.55	82.51	83.89
Yes	14.34	16.99	15.45	17.49	16.11
<b>Age grandmother (mean)</b>	52.85	55.91	53.69	54.65	54.57
<b>Self-rated health</b>					
Bad SRH	14.60	8.60	11.06	8.24	10.37
Good SRH	85.40	91.40	88.94	91.76	89.63
<b>Disability or chronic illnesses</b>					
Disabled	22.28	17.40	20.39	17.07	19.14
Healthy	77.72	82.60	79.61	82.93	80.86
<b>Distance in km (mean)</b>	11.87	18.11	7.16	9.86	12.89

Source: Belgian census 2001, calculations by authors; Note: column percentages for categorical variables and means for continuous variables.

#### 4.4. Modelling Strategy

We use multinomial logistic regression to model households' childcare arrangement, distinguishing (i) no care or childcare provided within the household, (ii) formal childcare, (iii) informal childcare, and (iv) combined informal and formal childcare usage. In a first model we include the household characteristics of the parents with a young child in the household, local childcare availability at the municipality level and the characteristics of the grandparents (Table 2). Households with no childcare arrangement or care provided within the household are the reference category. Second, we also consider alternative contrasts for this model (Table 3) to answer Hypotheses 1a–1d: we contrast (i) formal versus informal care, (ii) combined versus informal care and (iii) formal versus combined care. In a third step we test for interactions between grandparental characteristics and childcare coverage at the municipality level to test whether the effects of characteristics of the grandparents depend on the local availability of formal childcare (Hypothesis 2). In a fourth and final step, we test whether the associations between grandparents' characteristics and childcare arrangements differ depending on the labor market opportunities of mothers (Hypotheses 3a and 3b).

## 5. Results Multivariate Analyses

### 5.1. Uptake of Childcare by Household Characteristics

First we present the multinomial regression results on uptake of different childcare arrangements, distinguishing formal care only, informal care only, combined formal and informal care as opposed to having no care arrangement (see Table 2). We concisely discuss the control variables, before addressing the main explanatory variables and corresponding hypotheses.

**Table 2.** Multinomial analysis: uptake of childcare arrangement by grandmaternal characteristics and formal childcare availability, relative risk ratios, Belgium, 2001.

	Formal Care vs. No Care		Informal Care vs. No Care		Combined Care vs. No Care	
	RRR	Sig.	RRR	Sig.	RRR	Sig.
<i>Parental characteristics</i>						
<b>Migration background (ref. native)</b>						
2nd generation migrant	0.86	**	0.92	n.s.	0.68	***
<b>Education mother (ref. primary or lower secondary)</b>						
Higher secondary	1.13	*	1.05	n.s.	1.12	n.s.
Higher education	2.39	***	1.52	***	1.84	***
Higher academic	3.36	***	1.40	0.002	1.97	***
<b>Education father (ref. primary or lower secondary)</b>						
Higher secondary	1.20	***	1.16	***	1.33	***
Higher education	1.46	***	1.03	n.s.	1.49	***
Higher academic	1.38	***	0.63	***	0.97	n.s.
<b>Paternal employment</b>						
Education	0.77	n.s.	0.32	*	0.88	n.s.
Unemployed	0.43	***	0.45	***	0.45	***
Inactive	0.17	***	0.20	***	0.11	***
<b>Marital status (ref. married)</b>						
Cohabiting	1.21	***	1.07	n.s.	1.14	*
<b>Number of adults in the household (Ref. 2)</b>						
3 adults	0.64	**	0.96	n.s.	0.68	n.s.
4 or more	0.70	n.s.	0.80	n.s.	0.11	*
<b>Age child</b>	1.47	***	1.38	***	1.48	***
<b>Age at first birth</b>	0.98	n.s.	0.95	***	0.95	***
Probability employment	1.00	*	1.01	***	1.01	***
Probability fulltime work	1.01	***	1.00	n.s.	1.02	***
Probability flexible work	0.96	***	0.98	***	0.97	***
<b>Childcare coverage</b>	1.01	***	0.99	***	1.00	n.s.
<b>Satisfaction childcare provision (ref. bad)</b>						
Normal	1.03	n.s.	1.08	n.s.	1.06	n.s.
Very well	2.05	***	0.99	n.s.	1.96	***
<i>Grandmaternal characteristics</i>						
<b>Maternal grandparents known (Ref. both)</b>						
Mother only	1.06	n.s.	0.85	*	0.96	n.s.
<b>Marital status grandmother</b>						
Widow	0.98	n.s.	1.10	n.s.	0.96	n.s.
Divorced	1.07	n.s.	0.86	*	0.94	n.s.
Other	0.88	n.s.	0.76	n.s.	0.52	n.s.
<b>Employment grandmother (ref. inactive)</b>						
Employed	1.75	***	0.76	***	1.22	***
<b>Educational level grandmother (ref. low)</b>						
Higher secondary	1.19	***	0.95	n.s.	1.17	**
Higher education	1.45	***	0.73	***	1.18	**
<b>Live births</b>	1.01	n.s.	0.89	***	0.89	***
<b>Weekly care provision (ref. no)</b>						
Yes	0.98	n.s.	1.01	n.s.	1.06	n.s.
<b>Age</b>	1.01	***	0.99	n.s.	1.00	n.s.
<b>Self-Rated health (ref. bad)</b>						
Good SRH	0.96	n.s.	1.07	n.s.	1.07	n.s.
<b>Disabilities or chronic illnesses (ref. yes)</b>						
Healthy	1.04	n.s.	1.06	n.s.	1.07	n.s.
<b>Distance in km</b>	1.00	***	0.98	***	0.99	***
<b>constant</b>	0.50	n.s.	6.10	***	0.39	n.s.

Significance levels: n.s. = not significant, \*  $p \leq 0.050$ , \*\*  $p \leq 0.010$ , \*\*\*  $p \leq 0.001$ ; RRR = relative risk ratio; ref. = reference. Source: Belgian census 2001, calculations by authors.



Compared to natives, mothers with a migration background are significantly less likely to use formal care or combined formal and informal care as opposed to no care. There is no significant difference in the use informal care compared to no care use after controlling for other socio-demographic characteristics. The educational levels of both the mother and father are significant predictors of the childcare arrangement, with higher educated parents overall being more likely to have a care arrangement. With respect to informal care, higher educated mothers are more likely to have an informal care arrangement as opposed to no care arrangement, whereas the opposite is true for fathers with a higher academic degree. With respect to formal care, mothers with a higher academic degree are about 3.4 times more likely to use this type of arrangement rather than no care compared to mothers with only primary or lower secondary education. Paternal employment is also associated with the care arrangement in the household. When the father is unemployed or inactive rather than studying or employed, the household is significantly more likely to provide care within the household. Fathers in education are not significantly different from those who are employed. With respect to marital status, cohabiting parents are more likely than married parents to use formal care as opposed to no care, and they are a marginally more likely to use combined care as opposed to no care. When there are three adults in the household, parents are more likely to not to use care rather than using formal care. The older the child, the more likely care will be arranged outside the household. The older the mother was at the birth of her first child, the less likely she will use informal care or combined care as opposed to no care. Finally, employment of the mother is also an important predictor of care arrangement. Mothers with higher employment probabilities are more likely to use formal care or combined formal and informal care rather than no care arrangement. Yet, in line with theory, fulltime work does not increase the probability of using informal care as opposed to no care. Mothers with a higher probability of a flexible work arrangement are significantly less likely to use any type of care.

### 5.2. *The Availability of Formal and Informal Childcare*

Table 3 presents the results of the multinomial model where we contrast (i) formal versus informal care, (ii) combined care versus informal care, and (iii) formal versus combined care in order to provide a clear answer to the different hypotheses.

#### 5.2.1. *Formal Childcare Availability*

Childcare coverage at the municipality level has a significant positive association with the uptake of formal childcare rather than informal care use only (Contrast 1). This confirms our expectation that informal childcare use is being substituted as the sole care arrangement due to the increasing local availability of formal childcare (Hypothesis 1a). There is also a significant positive association with the uptake of combined formal and informal childcare rather than informal care only (Contrast 2). Hence, the increase of formal childcare also entails an increased use of informal childcare in combination with formal childcare arrangements. Finally, there is also a positive association of increasing formal care availability on the uptake of formal rather than combined care (Contrast 3). The results for the different contrasts taken together suggest that combined care will be used more often than informal care when formal childcare is more widely available, but formal care will increase more compared to the other two care arrangements. This implies that we can also confirm our Hypothesis 1b, which expected combined childcare to become more prevalent since we assumed that grandparental care would become more complementary to formal childcare when coverage increases.

#### 5.2.2. *Characteristics of the Maternal Grandmother*

With respect to availability of the maternal grandmother, a number of characteristics influence the uptake of formal childcare over informal childcare (Contrast 1). When we were only able to identify the grandmother or when she is divorced, parents are significantly more likely to make use of formal care rather than informal care only. The

maternal grandmother being widowed has no significant effect on the uptake of formal rather than informal care. The presence of a partner positively affects the provision of informal childcare, suggesting that it may be too intense to provide care when being alone. As expected, employment also indicates a lack of availability: when grandmothers are employed, parents are 2.29 times more likely to use formal rather than informal care only. The higher educated the grandmother, the less likely parents will solely rely on informal care.

**Table 3.** Uptake of childcare arrangement by grandmaternal characteristics and formal childcare availability, multinomial logistic regression with different contrasts, relative risk ratios, Belgium, 2001.

	Contrast 1 Formal vs. Informal Care			Contrast 2 Combined vs. Informal Care			Contrast 3 Formal vs. Combined Care					
	RRR	Sig.	[95% CI]	RRR	Sig.	[95% CI]	RRR	Sig.	[95% CI]			
<i>Parental characteristics (not shown)</i>												
<i>Local childcare</i>												
<b>Childcare coverage</b>	1.02	***	1.02	1.02	1.01	***	1.01	1.02	1.01	***	1.00	1.01
	<b>Satisfaction childcare provision (ref. bad)</b>											
Normal	0.96	n.s.	0.90	1.01	0.98	n.s.	0.90	1.07	0.97	n.s.	0.90	1.06
Very well	2.07	***	1.91	2.23	1.98	***	1.78	2.20	1.05	n.s.	0.95	1.15
<i>Grandmaternal Characteristics</i>												
	<b>Maternal grandparents known (ref. both)</b>											
Mother only	1.25	***	1.12	1.39	1.13	n.s.	0.97	1.32	1.10	n.s.	0.96	1.28
	<b>Marital status grandmother</b>											
Widow	0.89	n.s.	0.78	1.03	0.87	n.s.	0.71	1.07	1.02	n.s.	0.85	1.24
Divorced	1.24	***	1.12	1.39	1.09	n.s.	0.94	1.28	1.14	n.s.	0.98	1.31
Other	1.16	n.s.	0.71	1.90	0.68	n.s.	0.29	1.57	1.71	n.s.	0.76	3.85
	<b>Employment grandmother (ref. inactive)</b>											
Employed	2.29	***	2.16	2.42	1.60	***	1.48	1.74	1.43	***	1.32	1.54
	<b>Educational level grandmother (ref. low)</b>											
Higher secondary	1.26	***	1.18	1.34	1.23	***	1.13	1.34	1.02	n.s.	0.94	1.11
Higher education	1.98	***	1.84	2.14	1.63	***	1.46	1.81	1.22	***	1.11	1.34
<b>Live births</b>	1.13	***	1.11	1.15	1.00	n.s.	0.97	1.03	1.13	***	1.10	1.17
	<b>Weekly care provision (ref. No)</b>											
Yes	0.98	n.s.	0.91	1.04	1.05	n.s.	0.96	1.15	0.93	n.s.	0.86	1.02
<b>Age</b>	1.02	***	1.01	1.03	1.00	n.s.	1.00	1.01	1.02	***	1.01	1.02
	<b>Self-rated health (ref. bad)</b>											
Good SRH	0.89	*	0.81	0.99	1.00	n.s.	0.87	1.16	0.89	n.s.	0.78	1.03
	<b>Disabilities or chronic illnesses (ref. yes)</b>											
Healthy	0.98	n.s.	0.92	1.05	1.01	n.s.	0.91	1.11	0.97	n.s.	0.89	1.07
<b>Distance in km</b>	1.03	***	1.01	1.01	1.01	***	1.00	1.01	1.02	***	1.00	1.01
<b>constant</b>	0.08	***	0.04	0.18	0.06	***	0.02	0.19	1.28	n.s.	0.44	3.68

Significance levels: n.s. = not significant, \*  $p \leq 0.050$ , \*\*  $p \leq 0.010$ , \*\*\*  $p \leq 0.001$ ; RRR = relative risk ratio; ref. = reference; CI = confidence interval. Source: Belgian census 2001, calculations by authors.

With respect to potentially competing care demands, we find that for every additional child that the maternal grandmother had, the odds of using formal rather than informal care increase with 13 percent. Grandmothers' provision of care to people with chronic illnesses or handicaps at least once a week does not significantly affect parents' uptake of formal care over informal care. With respect to the personal health of the grandmother, we observe that age of the grandmother significantly affects informal childcare uptake: the older the grandmother, the more likely is becomes that parents use formal rather than informal care only. Having a grandmother with a good self-rated health decreases the chances of using formal care over informal childcare only. The presence of disabilities or chronic illnesses did not significantly affect the uptake of formal care over informal childcare only. Finally, the distance between the parental and grandparental home positively and significantly affects the uptake of formal care over informal care: a kilometer increase in the Euclidean

distance between the statistical sectors of residence of parents and grandparents increases the odds of using formal childcare over informal care with 1.01.

We expected the characteristics reflecting availability of the grandmother to provide informal care to be more important for the choice between formal care and informal care only (Contrast 1) than for the choice between formal and combined formal and informal care (Contrast 3), since grandmothers may still be available and willing to provide less intensive supplementary care (Hypothesis 1d). With respect to grandmaternal availability, we observe that having an employed grandmother significantly decreases the odds of using combined care as opposed to formal care. The same is true for grandmothers with a higher education, in contrast to results in a previous study by [Igel and Szydlik \(2011\)](#). The number of children, the age and the distance also significantly and positively affect the uptake of formal care over combined childcare. These results are very similar to the results determining formal versus informal care only. Compared to Contrast 1, self-rated health and marital status are no longer significant for Contrast 3, which implies that grandmothers may provide supplementary care when having no partner or having a poorer health. Additionally the odds-ratios for employment and education are less articulated for formal versus combined care (Contrast 3) compared to the choice between formal care versus informal care only (Contrast 1).

### 5.3. Variation in Grandmaternal Involvement Depending on Local Childcare Availability

We assumed that in a context of low overall availability of formal childcare, there is a higher need for grandparental childcare and that the lack of access to formal childcare could encourage grandparents to engage in childcare despite their own limited availability. This would imply that characteristics reflecting availability of grandparents could be less important in a setting with low formal childcare compared to a high availability setting (Hypothesis 2a). The model including interactions between the grandmaternal characteristics and childcare coverage at the municipality level was not a significant improvement considering a probability of Type-I-error of 1 per cent, however, over the model without interactions ( $\Delta$ -2LL: 59.32;  $\Delta$ df: 39;  $p$ -value: 0.0195). In addition, testing the interactions between grandmaternal characteristics and local childcare availability separately did not give any significant results<sup>1</sup>. The only exception seemed to be grandmaternal age ( $\Delta$ -2LL: 18.20;  $\Delta$ df: 3;  $p$ -value: 0.0004), but this concerned a small positive interaction between age and childcare coverage affecting the choice of not using care as opposed to informal care only (relative risk ratio = 1.001,  $p$  = 0.001). In sum, we reject Hypothesis 2, which expected that characteristics indicating grandparental availability would be less important in low formal childcare settings compared to a high availability setting. Contrary to expectations, grandmothers do not seem to respond differentially to the level of local childcare available to parents.

### 5.4. Variation in Grandmaternal Involvement Depending on Mothers' Employment Opportunities

In a last step, we investigate whether grandparental characteristics have a differential effect on the uptake of childcare arrangement by employment potential of the mother. The descriptives (Table A1 in Appendix A) indicate that mothers with low employment potential more often have no care arrangement or use informal care only. In contrast, mothers with a high employment potential have formal childcare only as the most common childcare strategy, followed by combined and finally informal childcare. The model including all interactions between mothers' estimated employment probabilities and grandmaternal characteristics is a significant improvement over the model without interactions accord-

<sup>1</sup> We performed likelihood ratio tests for the interaction between local childcare availability and whether maternal parents were known ( $\Delta$ -2LL: 1.68;  $\Delta$ df: 3;  $p$ -value: 0.6424), marital status ( $\Delta$ -2LL: 4.04;  $\Delta$ df: 9;  $p$ -value: 0.9073), employment ( $\Delta$ -2LL: 4.24;  $\Delta$ df: 3;  $p$ -value: 0.2364) educational level ( $\Delta$ -2LL: 13.55;  $\Delta$ df: 6;  $p$ -value: 0.0351), the number of children ( $\Delta$ -2LL: 0.58;  $\Delta$ df: 3;  $p$ -value: 0.9015), whether the grandmother provided care ( $\Delta$ -2LL: 6.92;  $\Delta$ df: 3;  $p$ -value: 0.0744), self-rated health ( $\Delta$ -2LL: 3.47;  $\Delta$ df: 3;  $p$ -value: 0.3251), the presence of a limiting chronic illnesses or disabilities ( $\Delta$ -2LL: 1.25;  $\Delta$ df: 3;  $p$ -value: 0.7414) and finally the distance between the maternal grandmother and the parents' place of residence ( $\Delta$ -2LL: 13.46;  $\Delta$ df: 3;  $p$ -value: 0.0037).

ing to the likelihood ratio test ( $\Delta$ -2LL: 134.74;  $\Delta$ df: 39;  $p$ -value: 0.000). We subsequently tested all the interactions between maternal employment probabilities and grandmaternal characteristics separately, but most interactions were not a significant improvement<sup>2</sup>. The only notable exceptions are the number of children ( $\Delta$ -2LL: 43.79;  $\Delta$ df: 3;  $p$ -value: 0.0000) and distance ( $\Delta$ -2LL: 19.72;  $\Delta$ df: 3;  $p$ -value: 0.0002). The inclusion of an interaction with the number of children changes the interpretation of the main effect when contrasting the uptake of formal care as opposed to informal care only. Having a grandmother with several children decreases the chances of using formal care over informal care (main effect: 0.76,  $p$ -value: 0.000), unless the mother has a high estimated employment probability (interaction effect: 1.01;  $p$ -value: 0.000). Similarly, for the interaction with distance: the main effect for distance remains in line with expectations – the further the distance, the less likely informal care is used as a sole strategy compared to the other arrangements – but the main effect for employment reverses. In the model with interaction, mothers with high employment probabilities are less likely to use formal care as opposed to informal care, but this effect is offset by the positive interaction effect between employment and distance, and we know that mothers with a higher employment probabilities live on average further away from the maternal grandmother (see Appendix A). Overall, we cannot convincingly conclude that grandmaternal characteristics differentially affect the choice between childcare strategies by employment potential (Hypotheses 3a and 3b), since most of the interactions were not significant.

## 6. Discussion and Conclusions

While grandparents constitute an important part of the childcare arrangements of many families across the European Union (Hank and Buber 2009; Igel and Szydlik 2011; Lewis et al. 2008), concern is rising that grandparents may become less available in the near future given the changing profile of older generations (Aassve et al. 2012a; Arpino et al. 2014; Gray 2005; Lewis et al. 2008). Among the reasons are demographic changes with respect to family formation, increased labor force participation of grandmothers, as well as policy changes intending to increase legal retirement ages and labor force participation at older ages (European Commission 2002). At the same time, formal childcare has become more widely available and the need for grandparental childcare may have declined. Nevertheless, the availability of formal childcare in most countries does not cover demand (European Commission 2014). This paper therefore investigated the uptake of childcare arrangements and distinguished between uptake of formal and informal childcare arrangements in contrast to previous literature. Subsequently, we investigated how the childcare arrangements of households are simultaneously influenced by the local availability of formal childcare, as well as the availability of informal care providers. This allows us to improve our understanding of the effect of grandparental availability on childcare arrangements, and whether informal care is substituted by formal care when the latter becomes more widely available.

Our results indicated that in municipalities with a higher availability of formal childcare, reliance on informal childcare as the sole care arrangement was less prevalent (confirming Hypothesis 1a), and that formal care thus seemed to substitute informal care use. Yet, higher availability of formal childcare at the local level did not completely abolish the use of informal care since we also found a higher prevalence of combined formal and informal childcare use over reliance on informal care as the sole care arrangement. This confirms Hypothesis 1b, which expected an increase in combined childcare because increasing availability of formal care would require less intensive care on the part of the grandparents and make their role more complementary to formal childcare. However, the results also showed a more pronounced increase of formal care rather than combined care as local coverage levels increase.

<sup>2</sup> We tested whether maternal parents were known ( $\Delta$ -2LL: 5.71;  $\Delta$ df: 3;  $p$ -value: 0.1263), marital status ( $\Delta$ -2LL: 23.70;  $\Delta$ df: 9;  $p$ -value: 0.0048), employment ( $\Delta$ -2LL: 11.07;  $\Delta$ df: 3;  $p$ -value: 0.0114) educational level ( $\Delta$ -2LL: 19.35;  $\Delta$ df: 6;  $p$ -value: 0.0036), whether the grandmother provided care ( $\Delta$ -2LL: 3.98;  $\Delta$ df: 3;  $p$ -value: 0.2632), her age ( $\Delta$ -2LL: 13.99;  $\Delta$ df: 3;  $p$ -value: 0.0029) her self-rated health ( $\Delta$ -2LL: 0.48;  $\Delta$ df: 3;  $p$ -value: 0.9234), the presence of any limiting chronic illnesses or disabilities ( $\Delta$ -2LL: 4.49;  $\Delta$ df: 3;  $p$ -value: 0.2136).

Additionally, our results also confirmed the expectation that the characteristics of the grandmother influenced the uptake of informal childcare as documented in previous literature, but they also showed that characteristics affecting the availability of the grandmother to provide care also affected the uptake of formal care, as well as the combined uptake of formal and combined care. We hypothesized that parents would be more likely to rely exclusively on formal childcare rather than exclusively on informal care, when grandmothers were less available (Hypothesis 1c). This was the case for a number of grandmaternal characteristics such as employment, being single, the grandmother having a larger number of children (which could indicate potentially competing childcare demands), her age and self-rated health, as well as the distance between the parental home and grandmothers' place of residence. Unlike previous research (Igel and Szydlik 2011) we found that having a higher educated grandmother negatively affected uptake of informal care. Having a grandmothers who gave care on a weekly basis to someone with a long standing illness or had any chronic illnesses did not significantly affect childcare arrangements. In line with our Hypothesis 1d, grandmaternal availability is more decisive with respect to the uptake of informal childcare as the sole care arrangement than for the uptake of informal care in combination with a formal care arrangement. Informal care might in this case be more supplementary and less intensive.

In addition to the association between childcare arrangements and the availability of formal and informal care providers, we also analyzed whether the association between grandparents' characteristics and households' care arrangements depended on the local availability of formal childcare. When there is little formal childcare available within the municipality, grandmothers may be more responsive to childcare demands regardless of their own situation. Previous qualitative research in the U.S. indicated that when parents are struggling with their childcare arrangements, grandparents sometimes become part of a complex childcare puzzle where they themselves have to juggle between other duties in order to help their children (Chaudry 2004; Meyer 2014). This situation has been documented among families with a high need for childcare but very little access to formal arrangements. Yet, contrary to our expectation, grandmothers did not seem to be responsive to the lack of formal childcare available to parents. This implies that when formal care is not locally available and grandparents are unavailable, a situation that may become more prevalent, some households may increasingly face problems to organize childcare.

Since previous research indicates that uptake of formal childcare is highly stratified by socio-economic status, it is often presumed that parents with a weaker socio-economic status substitute formal for informal care. Informal care offers practical benefits since it is usually more affordable and flexible compared to formal childcare, which is especially important to mothers in precarious employment positions who may face additional barriers in gaining access to formal childcare. However, research rarely addresses both types of care simultaneously and therefore lacks insight whether and to what extent this is the case. In this study, we expected that mothers with low employment potential are more likely to rely completely on informal care because of multiple reasons, such as flexibility, affordability, etc. but also because of a lack of access to formal childcare. Our results indicate that parents with a lower education and weaker labor market prospects are more likely to have no care arrangement or use informal care. However, we could not confirm the expectations that the association between grandparents' characteristics and parents' childcare arrangements differs systematically depending on whether mothers' have lower rather than more favorable employment opportunities (rejecting Hypotheses 3a and 3b).

### *6.1. Strengths and Limitations*

The Belgian census offers a rich source of information, and using linked microdata from the 1991 and 2001 censuses, complemented with contextual data on formal childcare provision at the municipality level, provided us with a unique dataset to investigate how childcare arrangements vary with characteristics of the parents, local childcare availability



and characteristics of grandparents. There are however a number of limitations which may be addressed in future research. First, we were unable to take intensity of care into consideration, while this has been shown to be important (Hank and Buber 2009; Igel and Szydlik 2011). Further research could investigate whether grandparental care is actually less intensive when combined with formal care use. Second, we assumed that informal care was largely provided by the maternal grandmother as previous research indicated that when informal care is used as primary care arrangement in Belgium, it is predominantly provided by grandparents (Ghysels and Van Vlasselaer 2007), but future research could further explore care provision in the wider kin network. Third, although we found a substantial amount of maternal grandparents, we were unable to identify all of them and cannot exclude that mothers who left the parental home earlier or started family formation later may be different in certain respects that could affect their decisions concerning childcare. Data infrastructures with improved coverage of descent could provide further insights into the access to informal care which was not covered in our paper. Fourth, previous literature has indicated that grandparents sometimes anticipate their grandparent role and withdraw from the labor market around the time of the first grandchild is born (Lakomý and Kreidl 2015; Van Bavel and De Winter 2013; Zanasi et al. 2020). This means that the employment status of the grandmother may also be confounded, since we did not control for anticipation of providing grandparental childcare. Future research may consider the use of longitudinal data together with predicted employment probabilities for grandparents to address these issues. Finally, this study could also benefit from more recent data, which could provide more insight into the current state of childcare arrangements made by parents.

## 6.2. Conclusions

Our results indicate that a higher availability of formal care does not simply crowd-out informal care use. While uptake of informal care as a sole arrangement was less prevalent when formal care was more readily available, a share of parents combined formal and informal care when grandparents were able to provide this additional care. Caregiving has an important function within a family as it can strengthen intergenerational solidarity, transmit norms and values and provide a safe and nurturing environment for children (Bengtson and Roberts 1991; Horsfall and Dempsey 2015; Wheelock and Jones 2002). On the one hand, parents may choose to combine formal and informal care because they value informal care and because grandparents want to be involved. On the other hand, it is also possible that there is an unmet care need on behalf of the parents because of a mismatch between parental characteristics and the formal childcare system. The results indicate that higher educated parents and women with stronger labor market positions use this type of care most often, when the grandmother and formal care are available. Yet, it was beyond the scope of this study to understand or investigate the underlying motivations to do so but it may be an interesting topic for further research.

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## Appendix A

**Table A1.** Descriptive statistics by estimated employment probability of the mother, row percentages.

Employment Potential Mother	Low	Medium	High	Total
<b>Childcare strategy</b>				
No care	59.9	25.2	14.9	100
formal	20.28	35.25	44.47	100
informal only	36.27	36.07	27.66	100
both	22.13	35.1	42.76	100
<i>Grandmother Characteristics</i>				
<b>Maternal Grandparents known</b>				
None	52.0	27.5	20.6	100.0
Both	26.4	35.3	38.3	100.0
Grandmother only	34.3	34.0	31.8	100.0
Grandfather only	34.1	32.8	33.1	100.0
<b>Marital status</b>				
Married	26.7	35.3	38.0	100.0
Widow	27.2	34.6	38.2	100.0
Divorced	37.4	34.0	28.6	100.0
Other	55.2	27.0	17.8	100.0
Total				
<b>Employment Status</b>				
Inactive	27.7	33.7	38.6	100.0
Employed	28.2	38.2	33.6	100.0
Total				
<b>Educational level</b>				
Primary and Lower Secondary	28.4	36.2	35.4	100.0
Secondary	23.0	34.8	42.2	100.0
Higher education	12.7	37.4	49.9	100.0
<b>Live births</b>	3.3	2.7	2.7	2.9
<b>Weekly care provision</b>				
No	28.4	34.9	36.7	100.0
Yes	22.7	36.6	40.7	100.0
<b>Age grandmother</b>	50.9	54.6	57.3	54.6
<b>Self-Rated Health</b>				
Bad SRH	40.7	32.0	27.3	100.0
Good SRH	26.4	35.4	38.2	100.0
<b>Disability or Chronic illnesses</b>				
Disabled	32.5	34.9	32.7	100.0
Healthy	26.8	35.1	38.1	100.0
<b>Distance in km</b>	9.9	13.1	14.9	12.9

Source: Belgian census 2001, calculations by authors; note: low, medium and high employment probability groups based on terciles.

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