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# Parental population exposure to historical socioeconomic and political periods and grand-child's birth weight in the Lifeways Cross-Generation Cohort Study in the Republic of Ireland

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ABSTRACT

Exposure to deprived socioeconomic conditions during the peri-conception and early childhood periods can have a negative long-term impact on individuals' health and that of their progeny. We aimed to examine whether relatives' birth period affected index-child (grand-child) birthweight status in the Lifeways Cross-Generation Cohort in the Republic of Ireland. Participants were 943 mothers and offspring, 890 fathers, 938 maternal grandmothers (MGM), 700 maternal grandfathers (MGF) 537 paternal grandmothers (PGM) and 553 paternal grandfathers (PGF). Index-child's birthweight was sex-for-gestational age standardised (UK1990 population), and then classified into low birthweight (≤10th percentile) and high-birthweight (≥90th percentile) and compared against normal-birthweight (> 10th to < 90th percentiles). Four adult birth periods were considered: The Free State (FS, 1916-1938); Emergency Act (EA, 1939-1946); Post-World War-II Baby-Boom (PWWII-BB, 1947-1964); and Modern Ireland (MI, 1964 onwards). Logistic regression was used to assess the crude and adjusted relationship between index-child's birthweight status and relatives' birth periods.

Overall, there were 8.7% (n = 82) index-children in the low-birthweight category, 77.9% (n = 735) and 13.4% (n = 126) within the normal and high birthweight groups respectively. Index-children whose mothers were born during the PWWII-BB had higher birthweight infants (Crude OR(COR) = 1.81 (1.08–3.03) which remained the case only for male index-children when adjusted for co-variables (Adjusted OR(AOR) = 4.61(1.71–12.42)). Parents' combined PWWII-BB birth period was positively associated with male index-child higher birthweight, even adjusted for maternal characteristics (AOR = 4.60(1.69–12.50)). MGFs born during the EA were more likely to have grandchildren with low birthweight after adjustment for maternal characteristics (AOR = 2.45(1.03-5.85)), particularly for female index-children (AOR = 4.74(1.16–19.25)). Both PGMs and PGFs born during the FS period had higher birthweight grandchildren, adjusted for maternal-related co-variables (PGM, AOR = 3.23(1.21–8.63); PGF, AOR = 3.93(1.11–13.96)), with the effect of PGM more evident in her grand-daughter (AOR = 6.53(1.25–34.04)). In conclusion, there is some evidence that period of grandparental birth is associated with their grandchildren's birthweights, suggesting that transgenerational exposures may be particular to historical context, meriting further exploration.

## 1. Introduction

In the last decades, many studies have supported the role of early-life events in the aetiological origin of disease and health status (Barker, 2007), suggesting the implication of different mechanisms that span biological, psychosocial, socioeconomic and environmental-related conditions. More recently it has been suggested these exposures may be mediated through genetic and epigenetic factors (Gluckman, Hanson, & Buklijas, 2010; Halfon, Larson, Lu, Tullis, & Russ, 2014). However, the pathways by which such conditions shape transgenerational health patterns are still unclear, since there are few longitudinal or cohort studies with historical and health data for more than two generations.

Studies have shown that exposure to deprived socioeconomic or psychosocial circumstances during the early-years of life might trigger negative health outcomes during adulthood (Ferraro, Schafer, & Wilkinson, 2016; Galobardes, Lynch, & Smith, 2008; Tamayo,

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Christian, & Rathmann, 2010). Moreover, some evidence suggests that significant historic exposures to adverse natural or man-made events (e.g. the Dutch and Chinese famines) may not only affect the exposed individuals' own health over the life course, but also extend across generations, affecting the health status of future children ( Huang, Li, Narayan, Williamson, & Martorell, 2010; Painter, Roseboom, & Bleker, 2005; Veenendaal et al., 2013).

The Irish population has experienced significant historical, economic and political events over the 20th century, including the War of Independence and subsequent establishment of the Irish Free State (1916–1938) (Corcoran, 2009), the Emergency period during World War II (WWII) when Ireland was a neutral political state (1939–1946) (Drisceoil, 1996), Post World War-II Baby Boom (1947–1964) (Van Bavel & Reher, 2013) and Modern Ireland from 1964 onwards (Fahey, Fitzgerald, & Maitre, 1998; Gerald, 1999; Whelan, 2013). Many people who were born, raised and lived through these periods may have experienced economic and psychosocial-related constraints or advantages for themselves and those of their households.

The Lifeways cross-generation cohort study in the Republic of Ireland provides the potential to examine cross-generational effects of such period exposures for Irish people over the twentieth century, especially those born and raised during the establishment of the Irish Free State and Emergency Powers Act in the WWII period. This is a three generation cohort study established a priori to examine cross-generational influences on the proband children (index-child) recruited during pregnancy in 2001–3 and several previous analyses have shown grand-parental influences on children's outcomes (Kelleher et al., 2014; McKey et al. 2017; Murrin et al., 2012; Shrivastava et al., 2012; Shrivastava, Murrin, Sweeney, Heavey, & Kelleher, 2013).

In the present analysis we examined whether the birth exposure of grandparents and parents to particular socioeconomic and political periods during the 20th century in Ireland was associated with the index-children's subsequent birthweights.

## 2. Methods

### 2.1. Data sources and participants

The Lifeways Cross-Generation Study design, methods, questionnaires and tools as well as follow up have been previously described in detail elsewhere (Kelleher et al., 2014; O'Mahony et al., 2007). The present cross-generation analysis involved the live born index-children of the Lifeways Cross-Generation Study as well as their parents and maternal and paternal grandparents (12 twin pairs were excluded).

Briefly, the Lifeways Cross-Generation Study is a prospective longitudinal study established between October 2001 and January 2003 in the Republic of Ireland, with an average follow up over a decade (2003–2017). The aim of this study was to examine the health status, diet, and lifestyles of parents, offspring and grandparents across the life course and to determine potential cross-generational links and associated risk factors for health outcomes. At baseline, 1132 pregnant mothers were recruited, whose pregnancy resulted in 1092 (94.5%) live born index-children, including 12 sets of twins, the majority of whom (98.2%) were born throughout the year 2002. Using validated questionnaires and follow up reporting forms, mothers provided information related to their own partners and all four lineages of the grandparents, including whether any of these were deceased. Specific gestation, delivery and postnatal associated information of the mother and offspring were also obtained from the hospital, delivery and immunisation records. In addition, the Lifeways Cross Generational Cohort has collected subsequent information of participants at three follow up periods when children averaged 3, 5 and 9 years of age. Finally, all index-child's grandparents were searched for in the General Register Office's database, and if recorded as deceased the date, age and cause of death were recorded.

For the purpose of the present analysis, based on the information available for both the index-child's sex-for-gestational age standardised birthweight (BW) and their relatives' birth period information, the following overall paired samples were separately analysed: (1) 943 index-child and mother pairs; (2) 890 index-child and father pairs; (3) 938 index-child and maternal grandmother (MGM) pairs; (4) 700 index-child and maternal grandfather (MGF) pairs; (5) 537 child and paternal grandmother (PGM) pairs; and (6) 553 index-child and paternal grandfather (PGF) pairs. Additionally, analyses were also performed by grouping grandparental birth period according to family lineage (maternal and paternal grandparents, resulting in following additional sample: 940 index-child and maternal grandparent (MGP)) pairs and 598 index-child and paternal grandparent (PGP) pairs.

For the 943 children with gestational age–for-sex standardised BW, the following grandparents' samples had known or inferred birth period: MGM = 938 (99.4%); MGF = 700 (74.23%); PGM = 537 (56.95%), and PGF = 553 (58.64%). Comparing the index-children with known or inferred grandparental birth period against those with unknown data (neither known, nor inerred) only for the MGF, PGM and PGF (as MGM only had five missing), it was found that children with known MGF's birth period information were more likely to have older mothers than those without valid MGF's birth period information, whilst those index-children with known or inferred birth period data for PGM and PGF tended to have mothers who were slightly older, more highly educated, smoked less and multiparous than those index-children with unknown PGM and PGF birth period information (Table A.1, Appendix A).

### 2.2. Ethical approval

The Lifeways Cohort received ethical approval for the various baseline and follow-up data collections initially from the ethical committees at the National University of Ireland, Galway; the Coombe Women's Hospital, Dublin; University College Hospital, Galway; the Irish College of General Practitioners; and later from University College Dublin; and St. Vincent's University Hospital, Dublin.

### 2.3. Main outcome: index-children's birth weight status

The index-children's birth weight status was standardised for sex and gestational age using the British 1990 reference population and using the Cole's LMS method (Cole, Freeman, & Preece, 1995) and LMSgrowth add-in for Microsoft Excel (http://www.healthforallchildren.com/shop-base/shop/software/lmsgrowth/) as the Irish population is more likely to be comparable to the British population rather than to other geographical population groups. Index-child was then classified as low birthweight (LBW) (children under the 10th percentile), normal weight birth weight (children between the 10th and 90th percentile), and high birthweight (HBW) (children over the 90th percentile). The normal weight category was considered the reference group in the analyses. The child's birth weight was recorded by health professionals in the hospital medical registry when the child was born.

### 2.4. Exposure factors: parental exposure to historical socioeconomic and political periods in Ireland's history

The following four socioeconomic-political periods in Irish history were considered as historically distinct: (1) The Free State (FS) period