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Arthritis and the risk of falling into poverty: a survival analysis using Australian data

Arthritis and the risk of poverty

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Abstract

Objective

Low income is known to be associated with having arthritis. However, no longitudinal studies have documented the relationship between developing arthritis and falling into poverty. This paper focuses upon Australians who develop arthritis to determine if they have an elevated risk of falling into poverty.

Methods

Survival analysis using Cox regression models applied to nationally representative, longitudinal survey data between the years 2007 and 2012 for Australian adults aged 21 years and over.

Results

The hazard ratio for falling into income poverty for females who develop arthritis is 1.51 (95% CI: 1.50 – 1.53), and for males the hazard ratio for falling into income poverty is 1.22 (95% CI: 1.21 – 1.23), relative those who never developed arthritis. The hazard ratio for falling into multidimensional poverty for females who develop arthritis is 1.87 (95% CI: 1.84 – 1.90) and for males the hazard ratio is 1.29 (95% CI: 1.29 – 1.30).

Conclusion

Developing arthritis increases the risk of falling into income poverty and multidimensional poverty. The risk for income and multidimensional poverty is higher for females. Given the high prevalence of arthritis, the condition is an overlooked driver of poverty.

There is a substantial body of literature on the indirect costs of arthritis, with multiple 'cost of illness' studies having been produced (1-6). The magnitude of the costs of arthritis is demonstrated by these studies, with some estimating that osteoarthritis alone accounts for between 1% and 2.5% of the gross domestic product of the United States, United Kingdom, Canada, France and Australia (5). Of these substantial costs, it is generally accepted that the indirect economic costs associated with lost productivity and lower levels of labour force participation are larger than the direct medical costs (7).

Arthritis has been linked in many studies to withdrawal from the labour force (4, 8-10). For example, within Australia, half of those with arthritis who are aged 45 to 64 are not in the labour force (10). Due to this reduced level of labour force participation many studies have also documented the lower income received by those with arthritis, with another Australian study showing that people who were out of the labour force due to arthritis have $1/5^{th}$ the income of their employed counterparts (11). However, these studies have taken a narrow view of how arthritis impacts upon the living standards of patients – looking only at employment and income.

Looking at the living standards of those with arthritis is important, as the condition is generally associated with morbidity rather than mortality, and as such the impact of arthritis is best captured through its impact on quality of life, rather than impacts upon mortality rate (7). Losina *et. al.* have shown that the number of Quality Adjusted Life Years (QALYs) lost for individuals with arthritis aged 50 to 84 was similar to that lost for people with conditions with high mortality rates, such as cancer or cardiovascular disease (12). Much attention has also been paid to how arthritis affects pain, mood, sleep, fatigue and other limitations on daily life (13-15). However, only one study has been conducted to assess the impact of arthritis on poverty rates – finding that those with arthritis were more likely to be in poverty regardless of

labour force status (16). Yet, this study utilised cross-sectional data and so it could not be determined which came first.

Poverty status is seen as a benchmark indicator of living standards (17) so it is surprising that there are few studies that test whether developing arthritis is a risk factor for falling into poverty – given the attention that has been given to measuring the quality of life of people with arthritis. Knowing whether arthritis is a risk factor for poverty is also important due to the sheer number of people affected by arthritis, giving the condition the potential to have a major influence on national poverty rates. Arthritis is a leading cause of morbidity internationally, with it being estimated that more than 1 in 8 adults have arthritis (18), and the number of affected people is expected to increase by 50% within the next 20 years (19, 20). As such, it may be possible that arthritis is an overlooked source of risk for poverty, which would add a further dimension to the reduction in living standards associated with developing arthritis. This paper uses survival analysis to show the risk people who recently developed arthritis have of falling into income poverty, using longitudinal data that is nationally representative of the Australian population. Internationally, there is an increasing trend to utilise "multidimensional poverty" measures (which consider multiple aspects of people's lives), in addition to move traditional "income poverty" measures (21, 22). As such, this study also undertakes a sensitivity analysis repeating the analysis using a multidimensional poverty measure.

Materials and Methods

Figure 1 illustrates the approach taken in this study. The population aged 21 years and over in 2007 who were not already in poverty and did not already have arthritis were followed through to 2012. The population was split into two groups: those who developed arthritis between 2007 and 2009, and those who did not develop arthritis. The proportion of people

who fell into income poverty between 2007 and 2012 was then compared for the two groups to determine whether developing arthritis was associated with an elevated risk of falling into income poverty.

Data set sampling and weighting

This study utilised longitudinal survey data from the Household Income and Labour Dynamics in Australia (HILDA) Survey. The HILDA survey is nationally representative of the Australian population living in private dwellings and aged 15 years and over, and has been conducted annually since 2001. The dataset is available, upon request, from the Australian Department of Human Services.

The survey sampling unit for HILDA is the household, with all members of the households that were included in Wave 1 (conducted in 2001) forming the sample that is to be followed over the life of the survey. The reference population for Wave 1 was all members of private dwellings in Australia. Household sampling was conducted in a three-stage approach. Initially 488 Census Collection Districts (each containing 200 to 250 households) were selected, within each district 22 to 34 dwellings were then selected, and finally up to three households within each dwelling were selected to be part of the original sample (23).

This study used the balanced panel of the HIDLA survey, which only included respondents who participated in Waves 1 to 12 of the survey, this excludes people who dropped out of the continuing person sample through death or by choice. Of the persons participating in Wave 1, 56.7% participated in each wave (23). These individuals were more likely to be female, in older age groups, a member of a couple or divorced, born in Australian or another English speaking country, be non-Indigenous, have a higher level of education attainment, be employed and have a higher skilled job (23). To adjust for this potential bias, the HILDA dataset contains longitudinal weights specifically to be used with the balanced panel, these

weights are described in the following paragraph. By using these weights the results will still be nationally representative of the Australian population, despite attrition from the survey.

The initial household cross-sectional weights in Wave 1 (upon which the weights in subsequent waves are dependant) were derived from the probability of selecting the household and were calibrated so that the weighted estimates match known benchmarks for number of adults by number of children and state by part of state. The person-level weights were based on the household weights and were then calibrated so that person weights match known benchmarks for sex by age, state by part of state, state by labour force status, marital status and household composition. Longitudinal weights for the balanced panel were based on the cross-sectional weights of wave 1 and were adjusted for attrition (24). To adjust for attrition a logistic model was constructed to calculate the probability of response, and includes as co-variates "age, sex, marital status, ability of speak English, employment status, hours worked, number of children, country of birth, highest level of education, relationship in household, health status, likelihood of moving, number of times moved in last 10 years, whether flagged as reference person for household" and interview characteristics (24). The adjusted weights were then calibrated back to known sex by age, state by part of state, state by labour force status, marital status and household composition benchmarks (24).

Income poverty measure

For this study, the authors measured income poverty in each wave from total regular annual disposable household income, which was composed of the total regular private income (wages and salary, business income, investment income, and private pensions and transfers), Australian government public transfers (government income support payments and other government payments, such as family or carer payments), other public payments such as scholarships, and foreign pensions received by each member of the household for the given

year, less tax. This total annual income was then equivalised for the number and age of household members using the OECD-modified equivalence scale (25). The cut-off point for being in income poverty was having an equivalised income less than 50% of the median equivalised income for the Australian population of all ages.

Sensitivity analysis: multidimensional poverty measure

A sensitivity analysis was conducted to test if the results were similar when using a multidimensional measure of poverty, which measures multiple aspects of peoples' lives in addition to their income. To measure multidimensional poverty, the Freedom Poverty Measure (26) was used. The Freedom Poverty Measure is a multidimensional measure of poverty developed specifically for the Australian population, it has been used in the past to assess the multidimensional poverty status of different sub-populations (27-29).

The Freedom Poverty Measure includes income, health and education attainment as the key capability indicators to identify whether an individual is in multidimensional poverty or not. These three factors were selected by the creators of the Freedom Poverty Measure as they were seen to be key capabilities that influence an individual's ability to participate fully within all aspects modern Australian society (including employment, social and civic participation) (26). Those who were in multidimensional poverty were considered to be in income poverty with at least one other form of disadvantage:

1. Those who had poor health and were in income poverty,
2. Those with a low level of education attainment and were in income poverty,
3. Those who had poor health, a low level of education and were in income poverty.

Health status was measured using the Physical Component Summary (PCS) and Mental Component Summary (MCS) scores from the SF-36 health survey (30), which was recorded on each wave of the HILDA dataset. The PCS was used to measure physical health and MCS

was used to measure mental health. Those defined as having poor health had a PCS or MCS score less than 75% of the average for their age.

Education attainment was measured in each wave and was based upon a person's highest level of education attainment reported in that wave. Having achieved lower than Year 12 (Year 11, Year 10 or below, Certificate I, Certificate II, or certificate undefined) was considered to be a low level of education attainment for those aged under 65; whereas for those aged over 65, Year 9 or lower was considered to be a low level of education attainment (31-34). Although highest level of education attainment is not expected to change much amongst the adult population, the influence of a lower level of education attainment does continue to impact upon living standards throughout a person's life (35-38). Education can also be improved should an individual wish to, or be able to, make that investment.

Measure of arthritis

In Waves 3, 7 and 9, the HILDA survey questioned respondents as to whether they had ever been told by a doctor or nurse that they have arthritis. The purpose of this paper was to investigate the risk of falling into poverty after developing arthritis. As arthritis status was not recorded on each wave on the survey, it was only known that arthritis was developed at some time between 2003 and 2007, or between 2007 and 2009. The authors deemed it more accurate to use the smaller time interval of 2007 to 2009 to identify those who recently developed arthritis, and so the analysis focused on data from 2007 onwards. Those who stated in Waves 3, 7 and 9 that they had not been told that they have arthritis were considered to have never had arthritis. Those who stated in Wave 3 and 7 that they had not been told that they have arthritis, but in Wave 9 stated that they had been told that they have arthritis, were considered to have developed arthritis between 2007 and 2009.

Sample size

There were 6,991 records on the balanced HILDA dataset. Those with invalid responses (stated they 'did not know' or refused the question) to the question 'Have you ever been told by a doctor or nurse that you have arthritis' were excluded (n=666). As we wanted to document the impact of those who were recently diagnosed with arthritis (between Waves 7 and 9) on the risk of falling into poverty, those who had been told they have arthritis prior to Wave 9 excluded (n=1566), and those who were already in income poverty in Wave 7 were also excluded (n=941). This gave a final sample size of 4,243.

Statistical Analysis

Interval censoring was taken into account as a part of the survival analysis. This occurs when periodic assessment is undertaken (such as the annual interview of respondents in the HILDA survey) and the event of interest (in this case poverty) is known to occur in the interval between two assessments. As the analysis was undertaken on the balanced panel of the HILDA dataset, only those who participated in every wave were included (as discussed above), as such respondents were only censored by the event of poverty or the end of the survey collection period in Wave 12 (2012).

An estimate of the survival function (survival being defined as not falling into poverty) was undertaken to explore how the survivor function for the two groups – those who developed arthritis between 2007 and 2009, and those who had never developed arthritis – changed over time. Possible confounding variables predictive of falling into poverty were analysed by univariate analysis using chi-square tests. The analysed variables were age in 2007, sex, marital status in 2007, home ownership in 2007, and remoteness of area of residence in 2007.

A Cox regression model was then computed to show the hazard function for falling into poverty for the two groups. All of the confounding variables were shown to be significant in

the univariate analysis, and so all were included in the modelling. Due to the known gender differences in the risk of developing arthritis and for outcomes of patients with arthritis (39), sex was included as an interaction term in the model.

The analysis was then repeated using the multidimensional poverty measure in place of the income poverty measure for the sensitivity analysis.

Statistical significance was defined as p=0.05. Data processing and analysis were performed with SAS9.4 (SAS Institute, Cary, NC, USA).

This study did not utilise human subjects. The use of the HILDA dataset was approved by the Australian Department of Social Services.

Results

There were 300 records of people aged 21 years and over in 2007 who developed arthritis between 2007 and 2009, and 3,943 records of people who had never had arthritis during this time period, who were not already in income poverty in 2007. Once weighted these records represented 454,100 and 6,084,600 people in the population respectively.

Of those who developed arthritis between 2007 and 2009, 50% were male and the average age in 2007 was 53.7 (SD=12.4). Of those who had never had arthritis, 54% were male and the average age in 2007 was 43.1 (SD=13.5). There was a significant difference in the age ($p<.0001$) and sex ($p<.0001$) distribution of those with and without arthritis. The distribution of the remoteness of area of residence in 2007 was not significantly different between the two groups ($p=0.1223$). However, a larger proportion of those who developed arthritis between 2007 and 2009 were married (81% vs 73%, $p<.0001$), and a larger proportion owned their own home rather than rented their home (82% vs 76%, $p<.0001$).

Income Poverty

Results of the univariate analysis show that females were significantly more likely to fall into income poverty (18% of females fell into income poverty, and 16% of males fell into income poverty, χ^2= 2192, p<.0001), the proportion of people in poverty generally increased with age (χ^2= 764666, p<.0001), the proportion of people in poverty increased with increasing remoteness of place of residence (15% of people in major cities, 19% of people in inner regional areas, 21% of people in outer regional areas, and 28% of people in remote areas were in poverty; χ^2= 26826, p<.0001), a higher proportion of people who were not married and not in a de facto relationship (24%) were in poverty as opposed to those who were married or in a de facto relationship (14%) (χ^2= 83759, p<.0001), and of those who did not own their own home, 22% were in income poverty, whereas 15% of those who did own their own home were in poverty (χ^2 = 41231, p<.0001).

Figure 2 shows the survival curve for falling into income poverty for those who developed arthritis between 2007 and 2009, and those who had never had arthritis during this time period. Those who developed arthritis between 2007 and 2009 had a lower survival probability at each time point throughout the 5 year study period. This is supported by the log rank chi-squared test of equality of the survivor function (χ^2=40498, p<.0001). At year 1 (2008), those who developed arthritis had a 0.9117 probability of not being in income poverty, those who had never developed arthritis had a 0.9535 probability of not being in income poverty. At year 2 (2009), those who developed arthritis had a 0.8409 probability of not being in income poverty, those who had never developed arthritis had a 0.9232 probability of not being in income poverty. At year 3 (2010), those who developed arthritis had a 0.7677 probability of not being in income poverty, those who had never developed arthritis had a 0.8913 probability of not being in income poverty. At year 4 (2011), those who developed arthritis had a 0.7481 probability of not being in income poverty, those who had

never developed arthritis had a 0.8641 probability of not being in income poverty. At year 5 (2012), those who developed arthritis had a 0.7256 probability of not being in income poverty, those who had never developed arthritis had a 0.8440 probability of not being in income poverty.

The estimated hazard rate for income poverty is shown in Figure 3. For those who developed arthritis between 2007 and 2009, the hazard rate of falling into income poverty was significantly higher (χ^2=40498, p<.0001). The risk for falling into income poverty for those who developed arthritis was highest in 2009 and declined between 2009 and 2011.

The Cox regression model shows that the effect of developing arthritis on the risk of falling into income poverty varies by gender (Table 1). The effect of developing arthritis is strongest for females. The hazard ratio for falling into income poverty for females who develop arthritis is 1.51 (95% CI: 1.50 – 1.53) and for males the hazard ratio is 1.22 (95% CI: 1.21 – 1.23), relative to those who never developed arthritis.

Table 1 also shows that being younger, married and owning your own home all decrease the hazard ratio for falling into income poverty, but living in inner regional or outer regional areas increases the hazard ratio of falling into poverty.

Sensitivity analysis: Multidimensional Poverty

Figure 4 shows the Kaplan Meier survival curve for falling into multidimensional poverty for those who developed arthritis between 2007 and 2009, and those who had never had arthritis during this time period. This shows that those who developed arthritis between 2007 and 2009 also have a lower probability of not falling into multidimensional poverty throughout the 5 year study period, and this is also supported by the log rank chi-squared test of equality of the survivor function (χ^2 =53816, p<.0001).

The estimated hazard rate for multidimensional poverty is shown in Figure 5, it is of a similar shape to the hazard rate for income poverty. For those who developed arthritis between 2007 and 2009, the risk for falling into multidimensional poverty was significantly higher than those who did not develop arthritis (χ^2 =53816, p<.0001).

The Cox regression model shows that the effect of developing arthritis on the risk of falling into multidimensional poverty varies by gender (Table 1). The effect of developing arthritis on the risk of falling into multidimensional poverty is again the strongest for females. The hazard ratio for falling into multidimensional poverty for females who develop arthritis is 1.87 (95% CI: 1.84 – 1.90), and for males the hazard ratio is 1.29 (95% CI: 1.29 – 1.30), relative to those who never developed arthritis.

Discussion

The results of this paper have shown that developing arthritis increases the risk of falling into income poverty, however the risk for income poverty was greater for females. Between 2007 and 2012, 24% of those who developed arthritis fell into income poverty, whereas only 14% of people who did not develop arthritis fell into income poverty. While previous cross sectional studies have pointed to the likelihood of this relationship, with those who have arthritis having higher odds of being in income poverty (16), no previous longitudinal studies have confirmed this. The results of the sensitivity analysis have also shown that those who recently developed arthritis still have a significantly higher risk of falling into income poverty when using a multidimensional measure.

Within the poverty measurement field, increasing attention is being given to measuring poverty over time (40) in order to determine the order in which forms of disadvantage develop, and also identify risk factors for falling into poverty. The use of longitudinal data overcomes some of the weakness of past cross-sectional studies of arthritis and income,

which were not able to identify the order in which arthritis and low income were developed (4, 9, 10). Indeed, the results have shown that arthritis is a significant risk factor for falling into both income and multidimensional poverty.

Given the high prevalence of arthritis, which is expected to increase within the coming decades (19, 20), arthritis should be seen as a major driver of national poverty rates. This, along with the high risk those with arthritis have of falling into poverty should warrant the attention of social security departments, in addition to health departments. This study has shown that the risk is greatest in the one to three years following diagnosis. This aligns with the findings of previous studies which show that there is a sharp decline in labour force participation soon after diagnosis with arthritis (41, 42, 43.). Australia does have social security arrangements for people who have medical confirmation that they cannot work due to a health condition and meet the eligibility criteria, with the United Kingdom and the United States offering similar arrangements (44-46). This means that people with arthritis could have access to an income safety net to provide a small level of income. However, social security payments are not seen as having the ability to keep an individual out of poverty (47). Given that multiple interventions have been shown to be effective in keeping people with arthritis in the labour force (42, 48, 49), more focus should be given to ensuring people with arthritis have access to these interventions.

The results in this paper utilised a measure of total household income, which included income obtained from regular private sources such as salary and wages, business and investment income, and private pensions, and also transfer income from government support payments such as the aged pension, disability pension and parenting payments. Government pensions reduce the prevalence of poverty by giving people with little or no income from private sources access to an income safety net, as discussed above. By including these government transfer payments in the measure of poverty, the true impact of developing arthritis on an

individual's private income is not revealed. So while this study has clearly shown the impact of arthritis on the risk of falling into income poverty, it has underestimated the impact of arthritis on private income.

This paper has sought to account for other explanations that could account for the relationship between developing arthritis and falling into income poverty, by including age, sex, marital status, home ownership and location as confounding factors. However, there may be other possible confounders that were not accounted for, such as co-morbidities. It is known that people with arthritis and two or more co-morbidities did have significantly lower incomes than those with only arthritis (50). Although the HILDA survey did question respondents about a select list of other conditions, this was a limited list and the survey did not question respondents about the relative severity of the conditions, or total numbers of co-morbidities.

This paper is limited in that the HILDA survey only asked respondents if they had ever been told by a doctor or nurse that they have 'arthritis', and did not differentiate between types of arthritis. As such, the risks associated with different types of arthritis cannot be determined. Furthermore, this relies on self-reported health status, which assumes the people are accurately able to recall whether have been told they have arthritis. There has been no validation of the self-reported health conditions for the cohort participating in the HILDA survey, however the questionnaire does ask respondents if a doctor or nurse has told them they have the condition. Furthermore, self-reported health data in general is seen to be a valid measure (51).

In spite of these limitations, this paper has been able to identify arthritis as a risk factor for both income poverty and multidimensional poverty. To the authors best knowledge this is the first study to document arthritis as being a risk factor for poverty, although the findings were not able to differentiate between types of arthritis. Given the high prevalence of arthritis

amongst the population of developed nations, arthritis is an overlooked driver of poverty rates.

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Table 1: Cox regression model to estimate hazard function of falling into income poverty and multidimensional poverty between 2007 and 2009

Parameter	INCOME POVERTY			MULTIDIMENSIONAL POVERTY		
	Parameter estimate	Hazard ratio	p-value	Parameter estimate	Hazard ratio	p-value
Arthritis – never	0.2002	REFFERENCE GROUP: results shown in Part B of Table	<.0001	0.3382	REFFERENCE GROUP: results shown in Part B of Table	<.0001
Age	0.0488	1.050	<.0001	0.0463	1.047	<.0001
Male	0.0985	REFFERENCE GROUP: results shown in Part B of Table	<.0001	0.2566	REFFERENCE GROUP: results shown in Part B of Table	<.0001
Male*arthritis-never	0.2141	REFFERENCE GROUP: results shown in Part B of Table	<.0001	0.3680	REFFERENCE GROUP: results shown in Part B of Table	<.0001
Married	-0.6970	0.498	<.0001	-0.9222	0.398	<.0001
Own home	-0.6167	0.540	<.0001	-0.6809	0.506	<.0001
Inner regional	0.1961	1.217	<.0001	0.4040	1.498	<.0001
Outer regional	0.4338	1.543	<.0001	0.2683	1.308	<.0001
PART B: EFFECT OF DEVELOPING ARTHRITIS VS NEVER DEVELOPING ARTHRITIS ACCROSS GENDER						
	Hazard Ratio	**95% CI**		**Hazard Ratio**	**95% CI**	
Female	1.513	1.500	1.526	1.867	1.837	1.898
Male	1.222	1.210	1.234	1.292	1.285	1.300

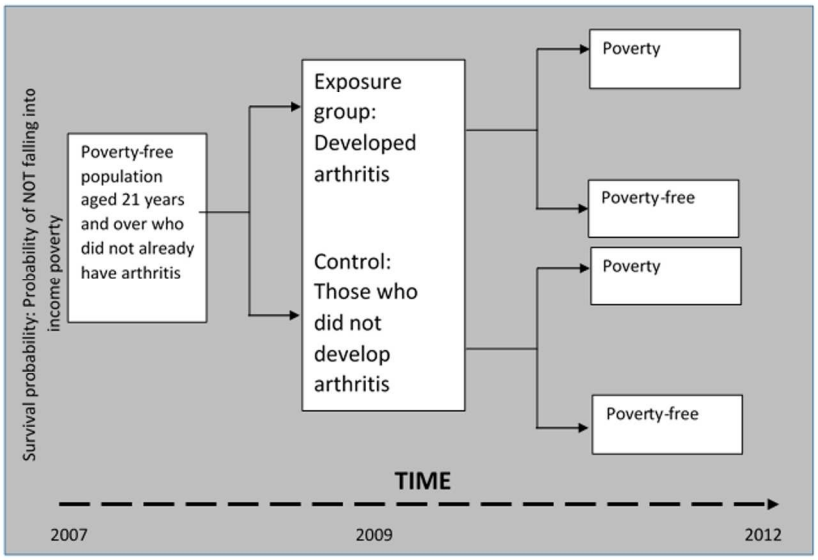
Figure 1: Analysis of risk of falling into poverty

Figure 2: Probability of not falling into income poverty over time (years) between 2007 and 2012 for those who developed arthritis between 2007 and 2009, and those who never had arthritis.

Figure 3: Estimated hazard rate of falling into income poverty between 2007 and 2012 for those who developed arthritis between 2007 and 2009, and those who never had arthritis.

Figure 4: Survival probability for multidimensional poverty over time (years) between 2007 and 2012 for those who developed arthritis between 2007 and 2009, and those who never had arthritis.

Figure 5: Estimated hazard rate of falling into multidimensional poverty between 2007 and 2012 for those who developed arthritis between 2007 and 2009, and those who never had arthritis.



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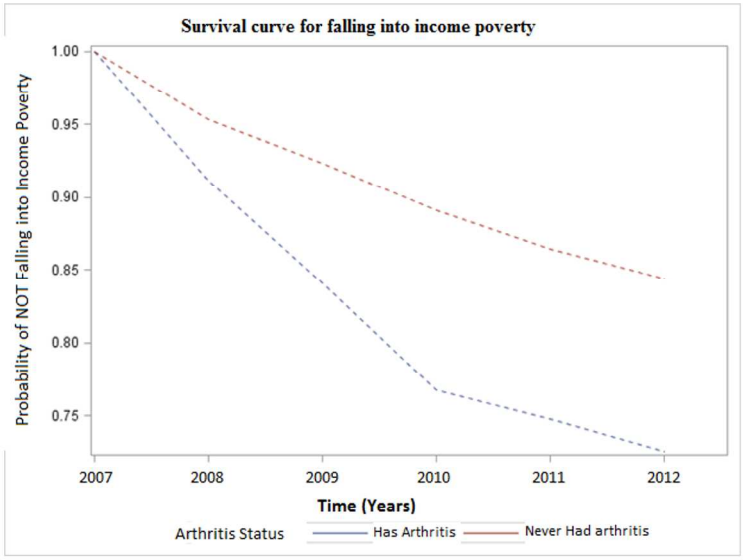

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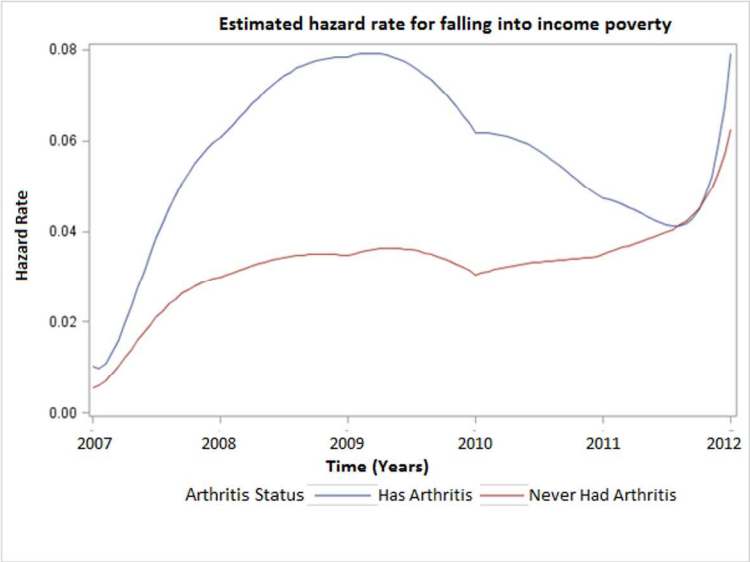

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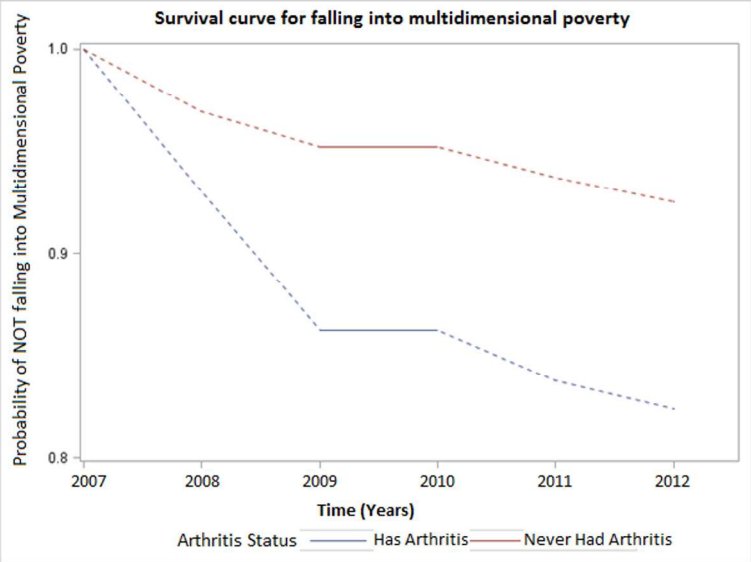

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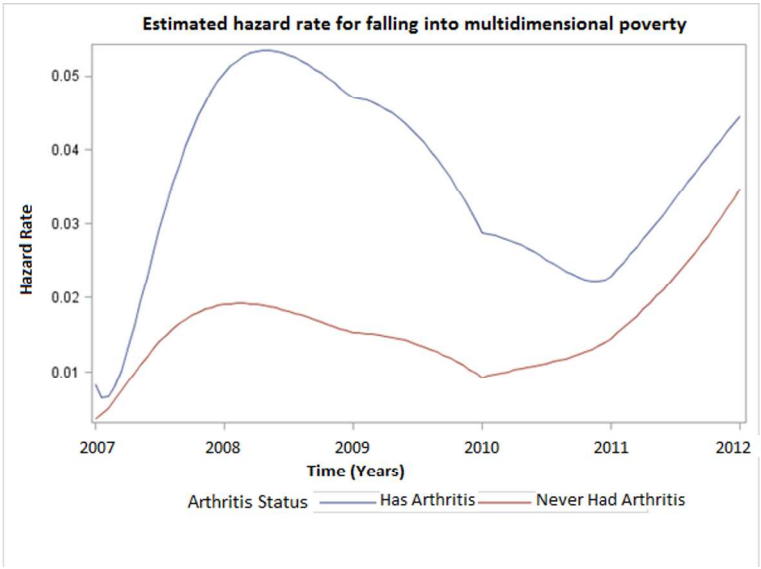

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