Report

Work disability caused by pregnancy-related pelvic girdle pain: prevalence and economic burden

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Abstract
pregnancy -related pelvic girdle pain (PPGP) is a common condition during pregnancy. In a few cases, it persists after childbirth. PPGP may result in temporary or permanent work disability, but there is little research on the prevalence and economic burden of this. The article addressed this by estimating for Norway in 2015 the prevalence of work disabling PPGP, the number of afflicted women, the number of person-years lost and the economic burden of the corresponding job absenteeism. Data from three sources were used: public registers of recipients of health-related benefits; surveys among currently and previously pregnant women, reported in other research articles; Statistics Norway's Births and Labour market statistics. Lower bound prevalence estimates suggested that 19.4 % of all pregnant women got temporarily work disabled due to PPGP during pregnancy, and that 0.068% got permanently disabled. This was equivalent to 11 300 pregnant work disabled women, corresponding to 1500 person-years of labour lost; and 1 500 women in working age with a permanent disability from a pregnancy in the past, resulting in an additional 800 lost person-years. These lost person-years represented an economic burden for the Norwegian society of 190 million USD. The results indicated that PPGP should be considered a major public health problem.

Keywords: Maternal health; pelvic girdle pain; work disability; economic burden of job absenteeism

1. Background

Pregnancy-related pelvic girdle pain (PPGP) is a musculoskeletal disorder affecting many women during pregnancy (Wu et al., 2004; Vleeming et al., 2008). It can lead to substantially reduced functional capacity and life quality, with difficulties in performing activities like lifting a light load, housework, childcare, and having a social life. In the worst cases, the women become housebound, bedridden and dependent on crutches or wheelchair (Larsen et al., 1999; Noren et al., 2002; Robinson et al., 2006; Elden et al., 2013; Engeset et al., 2014; Mackenzie et al., 2018). Although most women recover soon after giving birth, some experience persistent pain for months or even years after birth (Larsen et al., 1999; Noren et al., 2002; Albert et al., 2001).

PPGP can also lead to work disability, both on a temporary and permanent basis. The term *work disability* here describes inability to work, regardless of the duration or the degree[1] of the inability. Interview surveys from Norway suggested that about 45 % of all sick leave cases among pregnant women were due to PPGP (Dørheim et al., 2013; Malmqvist et al., 2015), and studies from Sweden found that some women got permanently unable to return to work due to disability from PPGP persisting after the pregnancy (Brynhildsen et al., 1998; Bergström et al., 2017). PPGP afflicts women in fertile age, i.e. early in life; and thus, any persistent problems can result in many life years of work disability. Together with the high prevalence during pregnancy, this implies that many person-years of labour are likely to get lost each year due to the condition, and this represents an economic burden for the society.

The purpose of this article was to estimate the number women in Norway suffering from work disabling PPGP and the economic burden of the associated job absenteeism. For this, five

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[1] A 100 % disability *degree* means that the woman is not able to work at all, whereas 50% means that her work ability equals 50% of full-time work.

outcomes were estimated for 2015, which was the latest year all relevant data were available for: i) prevalence and duration/degree of work disabling PPGP; ii) the total number of women of a working age with work disabling PPGP; iii) the number of these women that would have been employed had it not been for the disability; iv) the corresponding number of person-years of labour lost; v) the economic burden of the associated job absenteeism. In an economic cost of illness study, the economic burden would form part of the indirect costs (also referred to as productivity costs), which again form part of the total economic burden for the Norwegian society as a whole (the social costs) associated with PGPP (Jo, 2014).

The article does not only have a clear relevance for public health, but is also of novel interest. In a recent, systematic review of studies of the economic burden of maternal morbidity, Moran et al. (2020) were not able to identify a single study of PPGP; and to the best of the author's knowledge, this article is the first that attempts at estimating any type of economic burden associated with PPGP (outcome v). Furthermore, key outcomes in the calculation of this burden are the prevalence and the actual number of women suffering from work disabling PPGP (outcomes i-iii), but finding good background data for calculating such outcomes was a challenging task. There were several reasons for this: First, complete registers of afflicted women do not exist in Norway because the diagnostic systems applied do not always contain clear categories for the condition. The same systems are used in many countries around the world, and hence, similar problems are likely to exist elsewhere. Second, even though some scholars attempted at estimating general PPGP prevalence from interview/questionnaire surveys, only a few focused on work disability. Moreover, many surveys like that suffered from biases, i.a. because they relied on self-reported PPGP and had many nonrespondents (Vleeming et al., 2008). Third, underreporting of PPGP is likely to be a problem (Moran et al., 2020). The solution offered to these challenges was to combine existing raw data from secondary sources –registers as well as surveys, and calculate various prevalence estimates which differed in their underlying (unverifiable) assumptions. From these estimates the lowest and highest ones were selected and used as basis for the calculations of the other outcomes. This produced estimated ranges where the real and unobserved outcomes were likely to lie within. The ranges were inevitably large due to the data challenges but should nevertheless be of interest both to the research community and stakeholders since, to the best of the author's knowledge, more precise estimates do not exist, for Norway or elsewhere.

The case of Norway offers a particularly fruitful academic window for studying prevalence of work disabling PPGP. The reason is that Norway, despite the data challenges, is likely to be among the countries with the best data sources. Survey data exist for temporary receipt of health-related benefits due to PPGP during pregnancy, and register data exist for permanent receipt of health-related benefits due to PPGP persisting after pregnancy. Due to a public social security system with universal coverage, such data give a good reflection of prevalence of work disabling PPGP in the population.

2. Methods

Two types of secondary data sources were used for the extent of work disabling PPGP: 1) The Norwegian Labour and Welfare Administration (NAV) registers of women with permanent work disabling PPGP receiving disability benefits. Data on such recipients were provided from the NAV statistical department upon request, and they are further described in section 2.2. 2) Raw data from three interview/ questionnaire surveys of receipt of health-related benefits due to work disabling PPGP reported in the research literature. Data were taken from the published articles, and the three surveys were the only existing surveys found appropriate to use for the estimations undertaken in this article. The data and criteria for survey selection are described in section 2.3. Furthermore, in order to estimate all the outcomes of interest, the data from these two sources had to be combined with data from a third secondary source providing figures for the number of pregnancies and labour market indicators for women. Such data are publicly available and were collected from Statistics Norway's (SSB) website. They are described first, in section 2.1.

The method for calculating the outcomes of interest was as follows: First, various estimates of prevalence and duration/degree of work disabling PPGP were calculated to provide some background information (sections 2.2 and 2.3). They were calculated for two categories of PPGP: short-term disability during pregnancy and permanent disability from PPGP persisting after pregnancy. In the raw data there were some observations where information about work disabling PPGP only existed indirectly, or did not exist at all. To correct for possible biases this might cause (described in sections 2.2 and 2.3), a range rather than a point estimate were calculated –a commonly applied method in economics (see e.g. Manski, 1989 for an application to selection problems). The upper and lower bounds of the range relied on two different sets of, respectively, liberal (weak) and conservative (strong) unverifiable assumptions about prevalence among the non-observed cases. Consequently, the true, unobserved population prevalence was likely to lie within the range, and width of the range indicated the uncertainty around the estimate. An approach like that is useful in economic cost of illness analysis, as it provides estimates of the minimum and maximum expected costs associated with a given disease.

After having calculated the background estimates, the five outcomes of interest were calculated, and the method applied is described in section 2.4. In short, one lower and one upper bound prevalence estimate for each category of work disabling PPGP were selected among the background estimates as outcome number one and thereafter combined with the labour market indicators from section 2.1 to estimate the other outcomes of interest. Principles of standard economic cost-benefit analysis and the human capital method of cost of illness studies were applied to calculate outcome number five (the economic burden of work disabling PPGP).

2.1 SSB's statistics on Births and Labour market and earnings

As a proxy for the number of pregnant women in a given time period, the number of births was used. Unless otherwise is mentioned, all birth-related figures used in this article are publicly available from the Birth statistics of SSB (2020a), which origins from public registers. They are displayed in table 1.

Table 1. Number of births in Norway in different years

Year	1975 to 2014	2002	2003	2004	2005	2006	2014	2015	2016
# of births	2 250 508	54 557	55 587	56 087	55 875	57 713	58 344	58 240	58 147

Source: The National Registry, available from the Birth statistic of SSB (2020a)

The labour market indicators used in the article are summarised in table 2. They are either taken directly from the publicly available from the Labour market and earnings statistics of SSB (2020b), or calculated based on figures from those statistics in the manner described below. The statistics origin from either public registers or large-scale surveys, such as the Labour Force Survey, which can be expected to yield accurate information. To be comparable to the data described in section 2.2, all data regard 2015.

Sick listing relevance. Not all pregnant women with PPGP are entitled to sickness benefits. Only individuals who are employed, unemployed or students can be on sick leave, but not, for example homemakers. 89.4 % of all women in fertile age fell into one of the three categories, and thus this percentage was used as an estimate for the % of pregnant women for whom sick leave is a relevant metric. Fertile age is here understood as women aged 20-39 years, as these accounted for more than 95% of all births.

Employment rate. Not all women without work disabling PPGP are employed. Some may for example be unemployed, students, homemakers and some may have a work disability that is unrelated to PPGP. To estimate what the work participation among the PPGP disabled women would have been had it not been for the PPGP, employment participation among all working age women was used. Working age was here defined as 20 to 66 years old, as everyone above 66 years old was entitled to retirement pension, while women under 20 only accounted for 1.3% of all births. The % of women in working age that were employed – the female employment rate – amounted to 75.0 %.

Full-time equivalent (FTE) work percentage. Not all employed working age women work full-time. To estimate the number of person-years lost, part-time work had to be corrected for. 64% of working age women worked full-time, 25% worked long part-time (20 to 36 hours a week) and the rest worked short part-time (1 to 19 hours a week). The average number of worked hours per week for the two part-time groups was not available, but assuming that it amounted to 28 for long part-time and 10 for short part-time yielded an estimated FTE work percentage of 83.9 %.

Gross labour costs. According to SSB, gross labour costs for a full-time employee can be found by combining their Total labour cost statistic and their Index of labour costs, which yields costs equal to 746 922 NOK. However, the average wage for women only amounted to 90% of that for all employees, and thus, the average gross labour costs for a female employee was here estimated to 672 229 NOK. This was an approximation as some components of gross labour costs were not proportional to wages, but it was justified on the grounds that these components constituted a very small share of the total.

Table 2. Labour market indicators for women in Norway in 2015

Sick listing relevance	Employment rate	FTE work percentage	Gross labour costs
89.4 %	75.0 %	83.9 %	672 229 NOK

Source: author's calculations based on-, or data taken directly from the Labour market and earnings statistics of SSB (2020b)

2.2 Public registers of recipients of health-related benefits

Background data

The Norwegian Labour and Welfare Administration (NAV) keeps registers of residents in Norway receiving financial support from the public social security system due to health-related losses of work ability. The registers contain diagnostic information of the recipients, and since the system provides universal coverage, the number of recipients with a specific diagnosis is a good estimate of the total number of people of a working age suffering from work disability due to that diagnosis. However, well-defined categories for PPGP do not always exist in the diagnostic systems applied. Depending on the type of benefit scheme provided, two different systems, both developed by the World Health Organisation (WHO) and used in many countries, are relevant: the International Classification of Primary Care (ICPC) and the International Classification of Diseases (ICD) (Norwegian Directorate of eHealth, 2020a). Of these, only the latter has well-defined categories for PPGP, but that system is only used for recipients of *disability benefits*, which is a benefit provided for persons considered permanently unable to work (regardless of previous employment status) until retirement age. Before being granted disability benefits, however, a person typically goes through several years receiving other health-related benefits and being categorised in ICPC rather than ICD. People who get sick when they are employed or receive unemployment benefits are entitled to *sickness benefits* for up to one year (a similar scheme is available for sick students). After that, or immediately for people who are not in the labour force when they get sick, *work assessment allowance (AAP)* may be granted for a maximum period of five years. Consequently, women receiving disability benefits due to PPGP are not likely to have a short time disability caused by PPGP from a current pregnancy, but rather a permanent disability caused by persisting PPGP from a pregnancy in the past. The webpage of NAV (2020a) provides further information regarding the Norwegian social security system and available register data.

Through personal correspondence, the NAV statistical department informed that the ICD category currently used for recipients of disability benefits due to PPGP is M53.3 *Sacrococcygeal disorders, not elsewhere classified*. Previously O26.7 *Subluxation of symphysis (pubis) in pregnancy, childbirth and the puerperium* was used. Both are from the latest revision of ICD; revision 10. In revision 9, 6656 *Obstetrical damage to pelvic joints and ligaments* was used. Data for the number of new and existing recipients of disability benefits in these three categories were provided upon request from the NAV statistical department for 2011 to 2015. They are displayed in table 3 and can also be made available to other researchers and stakeholders upon request. The time range was chosen because figures prior to 2011 were not directly comparable to those after due to changes in the types of benefits available, and only data until 2015 were available when the collection was done (in 2019). *Primary diagnosis* denotes the main cause of the disability, whereas *secondary diagnosis* denotes additional diagnosis. [2]

[2] Information on secondary diagnosis is only available for some 60% of all disability recipients. Information from NAV registers about all disability cases used in this article can be accessed online at NAV (2020b) Statistics and analysis.

Table 3. Number of existing and new recipients of disability benefits due to PPGP

Year	2011		2012		2013		2014		2015	
Diagnosis	*Exist.*	*New*	*Exist.*	*New*	*Exist.*	*New*	*Exist.*	*New*	*Exist.*	*New*
Primary	385	34	404	38	430	34	473	50	477	34
Secondary	124	23	138	25	148	13	164	23	170	19
Total	509	57	542	63	578	47	637	73	647	53

Note: Recipients diagnosed in the ICD-10 categories, M53.3 and O26.7; and in the ICD-9 category, 6656. New recipients are part of the existing ones, which are counted by December each year. Source: NAV statistical department (personal correspondence, unreferenced).

Background estimates of prevalence and duration

Based on the figures in table 3, one lower and one upper bound prevalence estimate of permanent work disabling PPGP, which differed in the assumptions they relied on, were calculated. These are displayed in table 4. Both calculations relied on figures for new rather than existing cases because there is good reason to believe that the number of existing cases were heavily downward biased (see section 4.1). Both estimates were calculated by dividing the number of new cases each year by the number of pregnancies (proxied by the number of births displayed in table 1) nine years earlier, and then averaging over 2011-2015. The time span of nine years was chosen because the NAV statistical department informed that the newly disabled women with PPGP had, on average, been out of work for 9 years before having been granted disability benefits. Hence, a pregnancy 9 years back in time was likely to have caused the disability.

The lower bound prevalence estimate was calculated based on primary cases only and equalled 0.068% (ranging between 0.059 and 0.089 %). Here it was assumed that none of the women secondary diagnosed with PPGP would have been work disabled had it not been for the primary disability cause. This is a conservative assumption as some of these women could have been disabled even in the absence of the primary cause. Furthermore, the lower bound estimate relied on the assumption that diagnostic information existed for all the new PPGP cases. This assumption is also conservative; among all new recipients of disability benefits (regardless of diagnosis) there were some cases where diagnostic information did not exist, and there could very well be PPGP cases among these. On average, such undiagnosed cases amounted to 5.8 % of all diagnosed cases. The upper bound estimate relied on two alternative and liberal assumptions. The first one was that all the women with a secondary PPGP diagnosis would have been work disabled due to PPGP in the absence of the primary disability cause, and the second one was that prevalence of PPGP among the undiagnosed cases was equal to that for the diagnosed ones. The first assumption would yield a prevalence estimate equal to 0.105%, and the second one implies that this figure had to be multiplied by 1.058. Consequently, the upper bound prevalence estimate equalled 0.111 %.

Recipients of all types of health-related benefits described here are allowed (and encouraged) to make use of any residual work ability they might have by working part-time or periodically. In such cases, only a % of full benefits will be paid. This *payment degree* approximately equals 100% minus the % of full time worked during the year, and in 2015 the average among all cases primarily diagnosed with PPGP was 85.6 %. This corresponds to an annual number of 10.3 person-months of full-time equivalent disability. Information on payment degree did not exist for other years.

Table 4. Estimates of prevalence and degree of permanent work disabling PPGP, based on register data

Lower bound prevalence estimate primary cases, diagnosed	0.068 %
Upper bound prevalence estimates primary and secondary cases, diagnosed and undiagnosed	0.111 %
Disability degree (full-time equivalent person-months)	10.3

2.3 Interview and questionnaire surveys reported in other research articles

Background data

Some scholars have attempted to estimate prevalence of PPGP based on interview/ questionnaire surveys. In such surveys, the study population typically comprises women under antenatal or postpartum care at specific hospitals or maternity units during a defined time period, and many of them have been undertaken in Scandinavia. Wu et al. (2004) and Vleeming et al. (2008) provide good reviews. Whereas cost of illness studies are commonly based on prevalence estimates from such review articles, the estimates from Wu et al. (2004) and Vleeming et al. (2008) were not deemed appropriate for the estimations undertaken in this article. There were several reasons for this. First, a general problem with such surveys is that they may suffer from biases (Pannucci & Wilkins, 2010), and the surveys from the reviews were no exception to this, especially not the earlier ones. Sometimes the initial population was not randomly selected, and even when it was, self-selection was likely to be an issue since women suffering from PPGP may have been more inclined to respond, especially in the surveys focusing on the condition. In addition, misclassification was seldom corrected for even though it was likely to occur because many of the surveys were based on self-reported PPGP not confirmed by physical examination. Some surveys also did not distinguish between PPGP and pregnancy-related low back pain (PLBP), but studied both under the common term pregnancy-related lumbopelvic pain (PLPP). Second, there are issues with the reviews that are especially problematic in context of this article. Not everyone with PPGP are unable to work, but the reviews focused of prevalence of PPGP as such, and not prevalence of PPGP-related work disability. Furthermore, estimating prevalence of work disability based on surveys from different countries may be problematic since there is likely to be inter-country variation in the receipt of health-related benefits, for instance due to differences in norms or the generosity of the social security systems.

Consequently, rather than using data from the reviews as basis for the estimations undertaken in this article, data from a selection of recent surveys that specifically deal with many of the above-mentioned issues were used. Criteria for selecting suitable surveys were the following: the surveys had to be undertaken after 2000, the results had to be published in peer-reviewed academic journals, the study populations had to be unselected and the surveys had to study receipt of health-related benefits due to PPGP rather than general PPGP. Furthermore, to the extent possible, the surveys had to be conducted in Norway and study PPGP separately from PLPP. To the best of this author's knowledge, no surveys fulfilling these additional criteria exist for permanent work disabling PPGP. There is, however, one survey from the neighbouring and similar country Sweden, which was used instead (but with figures for PLPP being adjusted to comprise only PPGP in the manner described below). Bergström et al. (2017) did a 12-year follow-up of women with PLPP who had just given birth during some months in 2002. Results from the initial study were reported in Mogren (2006). For work disabling PPGP during pregnancy two surveys fulfilling all the above-mentioned criteria exist: Dørheim et al. (2013) and Malmqvist et al. (2015). Both of these were carried out during several months in 2008–2010.

Table 5 and 6 list the prevalence estimates calculated in the articles reporting the survey results (rows D and F) and the raw data used to calculate them (rows B–C and D–E). The tables also include information about the study population, i.e. number of women initially asked to participate (row A in table 5) and, in case of the 12-year follow-up, relevant information from the initial study (rows A–C in table 6). All these figures were taken from the published articles, and further details about survey design and other issues can be found there.

The average duration of sick leave during the pregnancy, was found to be 13.2 weeks in Dørheim et al. (2013) and 10.8 weeks in Malmqvist et al. (2015). However, only the latter study took into account that some women were on graded sick leave and reported the full-time equivalent of part-time leave. The equivalents in person-months are displayed in row E in table 5. For those receiving disability benefits (Bergstrøm et al., 2017), disability degree was not reported.

Table 5. Background data and estimates of prevalence and duration of short-term work disabling PPGP during pregnancy, based on survey data

Data from surveys		**Dørheim et al. (2013)**	**Malmqvist et al. (2015)**
A	# of women asked to participate (the study population)	4 814	994
B	# of respondents	2 769	569
C	# on sick leave due to PPGP	881	193
D	Estimated prevalence of sick leave due to PPGP: C/B	31.8 %	33.9 %
E	Estimated duration of sick leave (person-months)	3.03	2.48[a]
Adjustment factors			
F	Misspecification due to self-reporting	95.0 %	
G	Sick listing relevance (from table 2)	89.4 %	
Author's calculations			
H	Lower bound prevalence estimate: (C/A) * (F/G)	19.4%	20.6%
I	Upper bound prevalence estimate: D/G	35.6%	37.9%

Note: [a] full-time equivalent. Sources: author’s calculations based on raw data published in the two articles and, for adjustment factors, information from Hansen et al. (1999) (A) and SSB (B).

Table 6. Background data and estimates of prevalence of permanent work disability from PPGP persisting after pregnancy, based on survey data

Data from original survey, Mogren (2006)		
A	# of women asked to participate (the study population)	1 071
B	# of respondents	891
C	% respondents reporting PLPP	72 %
Data from 12-year follow-up survey, Bergstrøm et al. (2017)		
D	# of respondents answering the question on disability benefits	190
E	# reporting disability benefits due to PLPP	13
F	Estimated prevalence of disability benefits due to PPGP: E/D	6.8 %
Adjustment factors		
G	Misspecification due to self-reporting	0.95
H	Share of PPGP in PLPP	0.66
I	Succeeding pregnancies	1.71
Author's calculations		
J	Adjusting for initial study (lower bound): E/A	1.21 %
K	Adjusting for initial study (upper bound): F*C	4.93 %
L	Lower bound prevalence estimate: J*G*H/ I	0.45 %
M	Upper bound prevalence estimate: K*H/I	1.90 %

Source: author's calculations based on raw data published in the two articles and, for adjustment factors, information from Hansen et al. (1999) (A), Wu et al. (2004) (B) and Bergstrøm et al. (2017).

Background estimates of prevalence

In all three surveys from tables 5 and 6 practically all women giving birth at specific hospitals during a specific time period were asked to participate, thus the study populations should be considered unselected. However, like in most other surveys on PPGP, self-selection is still hard to rule out; due to a response rate below 100%, there were some members of the population were PPGP information was not available, and standard practices of calculating prevalence estimates based on the number of respondents rather than the population were followed. Furthermore, like in most of other PPGP surveys, self-reports rather than physical examination were used to determine the condition, and thus, misclassification can also not be ruled out.

But, unlike most other articles based on survey data for PPGP, this article corrects for these possible biases by using the method of calculating upper and lower bounds described above. As upper bounds, the prevalence estimates from the published articles were used (i.e. those displayed in rows D and F in tables 5 and 6). Although not stated explicitly, the estimation methods behind those estimates relied on the assumptions that the share of non-respondents with work disabling PPGP was equal to that for the respondents, and that there were no misreports. Despite that such assumptions are often made in survey-based estimations of PPGP prevalence, they should be considered liberal since they would cause upward biased in the presence of self-selection and misreports. To calculate lower bounds estimates, two alternative and conservative assumptions were undertaken here, namely that none of the non-respondents received health-related benefits due to PPGP and that 5% of the PPGP cases were misreports – a figure that is in line with findings in Hansen et al. (1999).

For these prevalence estimates to fit as background for calculating the outcomes of interest, it was necessary to make some additional adjustments to the upper as well as lower bound estimates. These were as follows. The estimates for PPGP during pregnancy were adjusted for the sick listing relevance factor from table 2 because it is likely that some of the pregnant women were not entitled to sickness benefits at the time they were surveyed. The adjustment ensured that the during-pregnancy estimates were comparable with the estimates for permanent PPGP (where sick listing relevance was not an issue since everyone is entitled to disability benefits).

Furthermore, three adjustments were done to the estimates of permanent work disability. First, to reflect prevalence among all pregnant women rather than just the group included in the 12-year follow-up (which was restricted to women reporting PLPP during pregnancy), prevalence had to be calculated relative to the original study. This correction resulted in the figures displayed in rows J and K in table 6. Second, the study reported PLPP rather than PPGP, and since PLPP comprises both PPGP and PLBP, the estimates were multiplied by 0.66 – an adjustment factor that was based on findings in Wu et al. (2004) indicating that about two thirds of the PLPP cases comprised PPGP. Third, the study did not report whether the women became work disabled from their 2002 pregnancy. For some women, succeeding pregnancies may have been the cause of the disability. On average, the women with PLPP 12 years after the pregnancy initially studied went through 0.71 succeeding pregnancies. This was taken into consideration by dividing the prevalence estimates with 1.71, which yields a good approximation when prevalence is small, like here.

These methods resulted in the lower and upper bound prevalence estimates shown in row H and I in table 5 (short-term disability) and L and M in table 6 (permanent disability).

2.4 Calculations of outcomes of interest

A schematic representation of the calculation method is given in Figure 1.

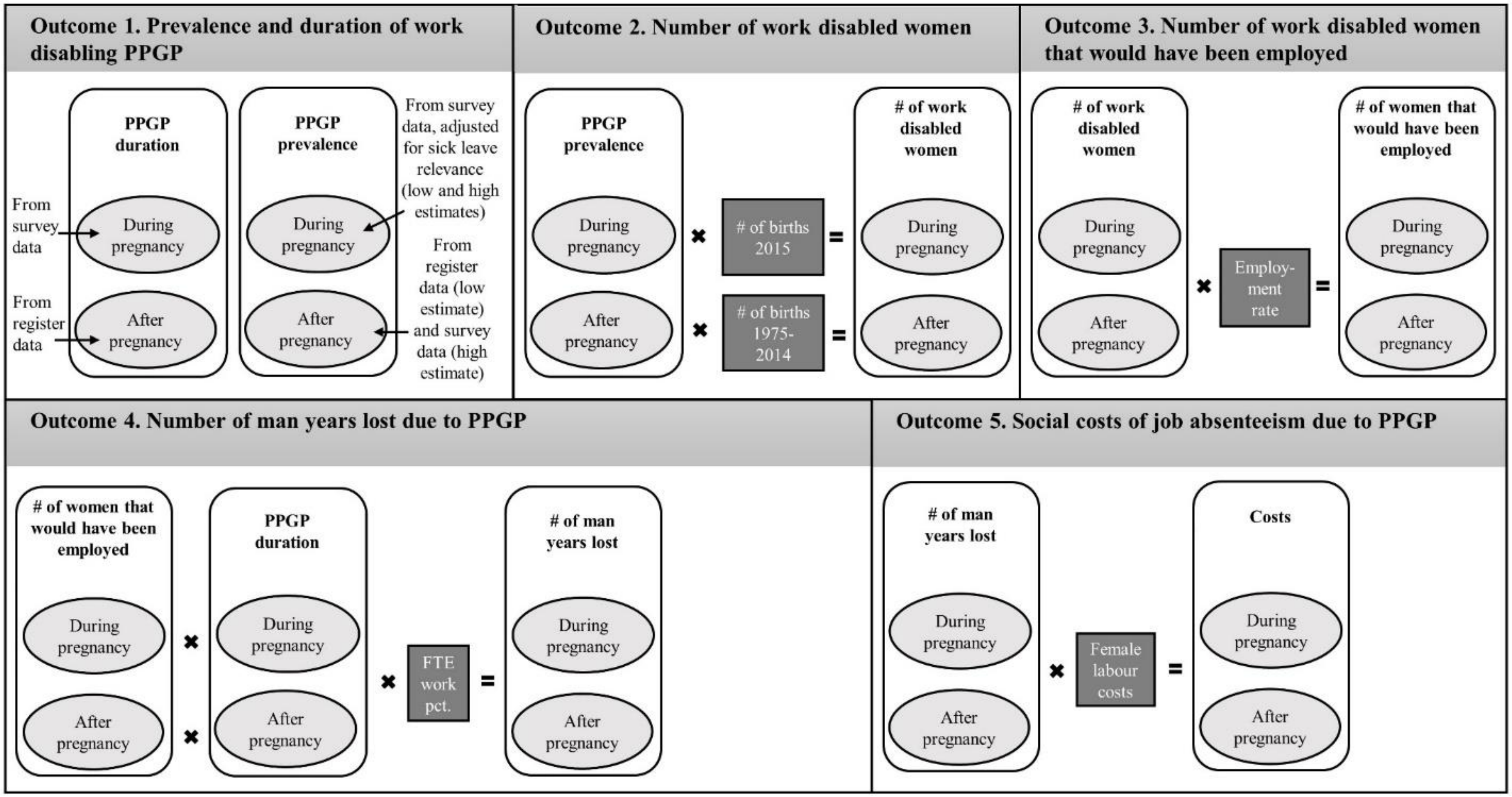

Figure 1. The method for estimating the five outcomes of interest. The calculations are consecutive, where the outcome from one step is used as an input in the next.

The first part of outcome number one –prevalence of work disabling PPGP– was produced by selecting among the background estimates displayed in tables 4–6 using the following principle: for each category of work disabling PPGP (short-term and permanent), the lowest and highest estimate from the register data and survey data combined were selected. This provided two ranges of estimates, one for each PPGP category. The second part of outcome number one–duration/degree of disability–was produced by using the estimated duration of sick leave from Malmqvist et al. (2015) for short-term disability and the NAV figure for average payment degree for permanent disability. The first estimate was chosen because it was the only one among the background estimates that reflected full-time equivalents of part-time sick leave, and the second was chosen because it was the only one available for permanent disability degree.

Outcome number one (displayed in table 7) was then combined with relevant SSB figures (table 1 and 2) to estimate outcomes number two to five (table 8). Outcome number two – the number of PPGP-work disabled women in working age – was calculated as follows: First, the number of women with a short-term disability during pregnancy was found by multiplying the during-pregnancy prevalence estimates (table 7) with the number of births in year 2015 (table 1). Second, to find the number of women with a permanent work disability due to PPGP persisting after childbirth, the following reasoning was applied: Each year, the probability of a pregnant woman getting permanently disabled from PPGP was $X\%$, where X refers to either the lower or the upper bound permanent prevalence estimates (table 7). In a given year t, F_t women gave birth, and thus, about $X\% * F_t$ new women became permanently disabled. The total number was found by adding together all new permanently work disabled women in all relevant years. One problem remained: over which years to summarise. To find this, the fact was used that a woman that gave birth in 1975 was, on average, 26 years old (SSB, 1995, table 4.8, p.74). Consequently, she had 41 years left in working life and would reach the last year of her working age in 2015. Since the average age when giving birth did not change considerably from one year to the next, each new cohort of women giving birth in years succeeding 1975 would also, on average, be of working age in 2015. Women who became work disabled from a 2015 pregnancy were counted in the during-pregnancy figures. Hence, the number of permanently work disabled women were found by adding together the figures for 1975-2014 (the sum of all F_t's are reported in Table 1).

The third outcome – the number of work disabled women that would have been employed had it not been for the PPGP – was found by multiplying the estimates for outcome number 2 (table 8) with the employment rate (table 2). Thereafter, the number of person-years lost (outcome number four) was found by multiplying the estimates of outcome number three (table 8) with the corresponding average duration/disability degree (table 7), and the FTE percentage (table 2).

Finally, the fifth outcome –the economic burden of the lost labour– was estimated by multiplying the figures for outcome number four (table 8) with the total labour cost for a female full-time employee (table 2). This method is in accordance with the human capital method of cost of illness studies and standard cost-benefit analysis, where the value of one person-year of labour is set equal to the gross amount employers would have been willing to pay for it (Jo, 2014; NOU 1997: 27; NOU 2012: 16). For more information, see e.g. NOU 2012: 16, p.28, where it was stated that «the inputs considered in a cost-benefit analysis shall be valued in the same manner as they would be valued by a private enterprise. Such use of producer prices means that labour is valued at the market wage before tax (inclusive of social costs) …». Market wage before tax should be understood as the enterprises' total costs of having an employee (p. 40).

3. Results

In order to not overestimate the consequences of work disabling PPGP, most focus is put on the lower bound estimates. The results for outcome number one (table 7) indicated that at minimum 19.4 % of all pregnant women in Norway got temporarily work disabled due to PPGP during the course of their pregnancy, and that they, on average, were fully disabled for 2.48 months. In addition, 0.068 % of all pregnant women, or slightly less than one in 1 500, became permanently work disabled, with an average ability to work of 1.7 (full-time equivalent) months annually. These were lower bound estimates. Upper bound estimates indicated that almost 40% of all pregnant women became temporarily work disabled and that 1.9% became permanently disabled.

Table 7: Estimates of prevalence and duration of work disabling PPGP

	% of women who get work disabled due to PPGP from one pregnancy		**Duration/degree of work disability** in months, annual full-time equivalents
	Low estimate	*High estimate*	*Estimate*
Temporary, during pregnancy	19.4%	37.9%	2.48 during the whole pregnancy
Permanent, after pregnancy	0.068%	1.901%	10.3 each year

Source. Author's calculations based on data from interview and questionnaire surveys, reported in the research literature, as well as public registers on recipients of disability benefits and the number of births. Some women experience temporary work disability after the pregnancy due to persisting PPGP that eventually passes. Estimates for this are not calculated.

Lower bound estimates for outcome number two to five (table 8) indicated that more than 11 300 pregnant women became temporarily work disabled from PPGP, and that almost 1 500 person-years of labour were lost as a consequence of this in 2015. In addition, more than 1 500 women of working age were already permanently disabled from a previous pregnancy, resulting in more than 800 additional lost person-years. Taken together, the associated job absenteeism represented an economic burden for the Norwegian society of more than 1 500 million NOK, or 192 million USD in 2015. Upper bound estimates, in turn, indicated almost 65 000 working age women with work disabling PPGP, and a corresponding social cost of more than 17 000 million NOK, or 2 166 million USD.

Table 8. Estimated consequences of work disabling PPGP in year 2015

	Temporary during pregnancy		Permanent after pregnancy		Total	
	Low	*High*	*Low*	*High*	*Low*	*High*
# of work disabled working age women	11 326	22 097	1 529	42 791	12 855	64 888
# of work disabled working age women that would have been employed	8 495	16 573	1 147	32 093	9 641	48 666
# man years of labour lost	1 473	2 874	826	23 112	2 299	25 985
Economic burden of labour lost (mill NOK)	990	1 932	555	15 536	1 545	17 468

Note. The term *work disabled* refers to inability to hold paid work regardless of the duration of the condition and the social benefits received. Estimates are based on figures for 2015, and the cost estimates are for labour lost in that year only, not labour lost in subsequent years. 10 NOK = 1.24 USD (Source: The Central Bank of Norway, https://www.norges-bank.no/tema/Statistikk/Valutaterminkurser/AAR-TERMIN-3M/). Some women experience temporary work disability after the pregnancy due to persisting PPGP that eventually passes. Women like that are not included in the estimates.

4. Discussion

This article has estimated prevalence of PPGP-related work disability in Norway and the economic burden of the corresponding job absenteeism. PPGP is considered a low back pain condition (Wu et al., 2004), and the results are relevant in relation to a recent study by Oslo Economics (2019) on back and neck pain in Norway – the most important causes of absence from work as well as years lived with disability. The study found that in 2018, 149 820 people were sick-listed due to such conditions (of which 52% were women), 12 041 received AAP and 33 104 received disability benefits. The economic burden of job absenteeism due to these conditions were estimated at 41 400 million NOK (table 6-1, p. 32), corresponding to 38 192 million NOK at 2015 values (adjusted for the inflation using the Consumer price index calculator of SSB (2020c). Consequently, if the figures from Oslo Economics (2019) were similar for 2015, the results reported in table 8 should indicate that the economic burden from job absenteeism due to PPGP amounted to at least 4 % of the burden associated with back and neck-pain. It should be noted, however that, it is likely that the estimates by Oslo Economics (2019) did not capture all PPGP-related job absenteeism because some women with PPGP, especially pregnant ones, were likely to be diagnosed in categories not related to back and neck pain (see below).

To the best of this author's knowledge, previous studies estimating prevalence of PPGP relied solely on surveys. In part this article also did that but combined the survey estimates with register data-based estimates when relevant data were available. Furthermore, the impact of potential biases was addressed by using the raw data from the original surveys to calculate additional prevalence estimates under alternative (unverifiable) assumptions of non-respondents and degree of misclassification, and ranges rather than point estimates of prevalence were provided. As indicated by the width of these ranges, there were large uncertainties around the estimates, and these uncertainties are further discussed in section 4.1. To estimate the economic burden, the prevalence estimates were combined with labour market indicators for women based on reliable data from SSB. Some issues also exist regarding use of these, and these are discussed in section 4.2.

4.1 Estimates of the first outcome: prevalence and duration/degree of work disabling PPGP

The survey-based estimates applied in the analysis were based on the studies that were deemed the most appropriate.[3] However, due to quite limited study populations, a high number of non-

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[3] There were two additional surveys of sick leave among Norwegian women that could have been deemed appropriate: the survey reported in Stafne et al. (2019), carried out during 2007 to 2009, and one of the surveys reported in Gutke et al. (2014), carried out in the late 1990s. These studies have the advantage of being prospective, and hence, some type of biases (like observational bias) can be expected to be lower. Even so, they were not included here because they did not distinguish between

respondents and various sources of possible misclassification, there is uncertainty around the estimates. This especially regards permanent work disabling PPGP. It is nevertheless comforting to notice that none of the survey-based background estimates for persisting PPGP from section 2.3 exceeded that found in the meta-analysis of Wu et al. (2004), which built on a large number of surveys. They focused on PLPP rather than PPGP and concluded that the condition persists after childbirth for about 25% of all pregnant women, and that 1/5 of these experience serious problems. Downscaling with a factor of 0.66 % to account for some of the PLPP cases comprising PPGP (Wu et al., 2004), this yields an estimated prevalence of severe persisting PPGP of about 3.3%. Duration or disability degree was not addressed by Wu et al. (2004), but Vleeming et al. (2008) held that the condition disappears soon after childbirth for most women, but that prognosis are worse for the most serious cases (they did not provide an estimate for persisting PPGP beyond this).

The survey-based background estimates for PPGP during pregnancy from section 2.3 are supported by the fact that the two surveys they were based on reached very similar conclusions. Furthermore, they are fairly in line with the findings in Wu et al. (2004), who concluded that 45% of all pregnant women suffer from PLPP at some stage during their pregnancy, with more

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PLBP and PPGP and moreover had somewhat stricter inclusion criteria than those included. However, it would not have mattered if they were included, as both lower and upper bound prevalence estimates from those studies would have been inside the range of the during-pregnancy estimates displayed in table 7. Furthermore, there was also one other Swedish 12-year follow-up survey on receipt of disability benefits that could have been deemed adequate (Brynhildsen, et al., 1998). This was also not included because it was relatively old and only followed up women with severe enough pain to be sick-listed during the pregnancy. However, also in this case inclusion would not have mattered, as neither lower nor upper bound prevalence estimates would have been outside the range of the after-pregnancy-estimates displayed in table 7.

than half of these – 25% of all – experiencing serious pain. Again, downscaling with 0.66, these results indicate that around 30% of all pregnant women get PPGP and that 16.5 % are severely afflicted. Also the meta-analysis of Vleeming et al. (2008, p. 800) provided a prevalence estimate for PPGP during pregnancy, but they reported point prevalence, which refers to prevalence at a specific time of measurement, rather than period prevalence, which is generally higher and what we are interested in here. They concluded that there was strong evidence of a point prevalence of PPGP during pregnancy close to 20 %.

Both the lower and upper bound prevalence estimates for PPGP during pregnancy applied here were based on survey data rather than register data, which were not found reliable enough. The reason is that Norway, as many other countries, uses the ICPC system to diagnose women experiencing PPGP during pregnancy, and this has far less detailed categories than the ICD system (Norwegian Directorate of eHealth, 2020a). Several ICPC categories may be used for PPGP. In its Guide to sick listing the Norwegian Directorate of Health (2020b) now recommends three pregnancy-related categories (none of which are related to low back pain): W28 *Limited function/disability*, W29 *Pregnancy symptom/complaint other*, W99 *Disorder pregnancy/delivery*. However, none of these are exclusively reserved for PPGP, and they also cover a large number of other conditions. In addition, they are not likely to cover all PPGP cases for four reasons: First, in 2000 the predecessor of NAV, RTV (2000), stated that L99 *Musculoskeletal disease, other* was commonly used for PPGP, and this may still be the case among many doctors despite the new recommendations. Second, the ICD and ICPC systems link ICD M53.3 to ICPC L03 *Low back symptom/complaint* and ICPC L84 *Back syndrome w/o radiating pain* (Norwegian Directorate of eHealth, 2020a). Third, Helde & Nossen (2016) found that one third of all sick-listed pregnant women had non-pregnancy-related diagnoses of which the largest group–30%–were musculoskeletal conditions. Fourth, PPGP is more likely to strike later in the pregnancy (Wu et al., 2004), but if the woman was diagnosed with another condition at an earlier stage in the pregnancy (like for example W01 *Question of pregnancy*), the diagnosis may not have been changed (Helde & Nossen, 2016).

A source of uncertainty around the during-pregnancy estimates is that they were calculated taking into consideration that certain groups are not entitled to sickness benefits. However, if anything the method should lead to downward bias; students and unemployed women with work disabling PPGP were assumed to be sick-listed, but this may not hold as sickness schemes for these groups are stricter than for employed people. Duration may also have been underestimated. The estimate from Malmquist et al. (2015) was used, but average duration of sick leave reported in the alternative source–Dørheim et al. (2013)–was not only higher but also likely to be downward biased because the respondents were last surveyed in gestational week 32. Consequently, sick leave between gestational week 32 and 37 was not counted. (In week 37 the woman must start maternity leave and can no longer be sick-listed.)

A source of uncertainty around the survey-based estimates for persistent PPGP is that they relied on data from Sweden rather than Norway. However, bias this might cause is also likely to be downward, as Sweden has been found to have a lower level of sick leave during pregnancy than Norway (Truong et al., 2017), and it also has a somewhat less generous social security system.

The analysis only considered two categories of PPGP-related work disability: short-term disability during pregnancy and permanent disability after pregnancy. However, some women experience medium-term disability from to PPGP persisting some time after childbirth but eventually disappearing (Wu et al., 2004; Vleeming et al., 2008). It was nevertheless considered necessary to disregard such women in the analysis due to unavailable data even though this leads to underestimation of the number of PPGP work disabled women. Very few surveys report comparable prevalence estimates of such medium-term PPGP-related absence from work at different years after childbirth. One exception is Bergström et al. (2016), who, based on the same initial study as Bergström et al. (2017), reported prevalence of PPGP-related sick leave at 6 and 14 months after the birth. However, such short time after the birth, several women are still likely to be on maternity leave, hence it seems inaccurate to use sick leave prevalence as an indication of work disability. Furthermore, also in this case, the relevant NAV register data are recipients of sickness benefits and AAP, which cannot be used since they are categorised in the ICPC system.

For prevalence of permanent PPGP-related work disability, the NAV data were deemed sufficiently reliable, and the lower bound estimate used in the analysis was based on these. Prevalence was calculated using figures for new, rather than existing recipients of disability benefits because the latter were likely to heavily underreport the true number of permanently PPGP work disabled women. This can be seen merely by noticing two facts from table 3. First, in a given year the number of new recipients was generally much higher than the number of recipients that ceased to receive benefits.[4] However, the two figures should be fairly similar unless PPGP became much more prevalent during the last decades, something which is generally rejected by the research literature (Wu et al., 2004; Berg et al., 1998). Second, the number of new recipients constituted almost 10 % of existing ones. But, since new recipients each year

[4] A good proxy for the latter number can be found by subtracting the number of new from existing cases in a given year and compare with the number of existing cases the year before.

cumulates into existing cases in subsequent years, and PPGP afflicts pregnant women with many years left in working life, a much smaller ratio of new to existing recipients should be expected.

There are also other indications of PPGP having been under-diagnosed rather than uncommon in the past. Moran et al. (2020) argues that PPGP have been frequently underreported, and there has been considerable professional disagreement about clinical manifestations, treatment and prognosis of the condition (Wu et al., 2004; Kanakaris et al., 2011). In Norway, it was unclear whether PPGP was a valid diagnosis for sick leave until around 1990 LKB (1990), and international guidelines for diagnostics did not exist until 2008 (Vleeming et al., 2008). This indicates that the condition was less known and less accepted, both professionally and socially, in the past.

Though the situation is different today, underreporting may still be an issue. PPGP is a clinical pain syndrome with unknown causal mechanisms, and evidence for effective treatment methods is limited (Wu et al., 2004; Kanakaris et al., 2011). In Norway (and most likely in many other countries), pain conditions afflicting women, especially those that are chronic, have low prestige among doctors (Album & Westin, 2008). PPGP is no exception, and no medical specialty has a defined responsibility for the condition (Juel, 2010). As described above, the diagnostic system used in primary care around the world does not have well-defined categories for the condition. In the Norwegian register of recipients of disability benefits, a specific category from the diagnostic system used in specialist care is reserved for PPGP, but there is no common international practice among doctors on which category to use. The category used in the Norwegian register has also changed over time.

These factors may indicate that also the figures for the new disability recipients underreport real numbers. The suspicion is supported by the fact that the upper bound register data-based background estimate for prevalence of persisting PPGP calculated in section 2.2 amounted to a mere ¼ of the lower bound survey-based estimate calculated in section 2.3.

Two additional factors pull in the direction of downward bias of the estimates of persistent PPGP. These regard the lower bound (register data-based) estimate as well as the upper bound (survey data-based) estimate. Firstly, both estimates regarded receipt of disability benefits, not sickness benefits or AAP, which means that long-term, but periodic PPGP was disregarded. Such PPGP has indeed been found to occur (Bergström et al., 2017). Secondly, disability benefits are generally only granted for disability degrees of at least 50% NAV (2020a), and thus, labour lost due to lower disability degrees was also not included.

Summing up, though the most reliable data available have been used, uncertainty around the estimates reported in table 7 and 8 is substantial. For PPGP during pregnancy, the upper bound prevalence estimate is two times larger than the lower bound one, and for PPGP persisting after childbirth, it is almost 30 times larger. In order to avoid overestimation, the focus should be on the lower bound estimates. It is likely that these do not overestimate the real prevalence, but rather underestimate it. As demonstrated, they have been calculated using very conservative approaches.

4.2 Estimates of outcomes two to five: number of disabled women, lost person-years and the social cost of job absenteeism

There is also some uncertainty related to the labour market indicators used in the analysis. Such indicators typically differ between different groups of people, something which is partly taken into account by using figures for women in relevant age groups rather than for the whole population. However, more detailed data would have been preferable. It is well-known that low skilled workers are more likely to have poor health (see e.g. Cutler and Lleras-Muney, 2014) and

PPGP is no exception. Studies have found that the condition is more common among women with lower education (Stafne et al., 2019) and heavy physical work (Wu et al., 2004; Vleeming et al., 2008). Consequently, PPGP-afflicted women can be expected to earn below the average. Moreover, in some heavy-work industries like cleaning and care, prevalence of part-time work is particularly high (Næsheim & Lohne, 2003). These factors are likely to lead to overestimation of the employment rate, FTE percentage and gross labour costs. Even so, one should not conclude that the lower bound estimates displayed in table 8 are upward biased because any overestimation of the labour market indicators is likely to be reversed or at least heavily dampened by the likely underestimation of prevalence. Ideally, labour market indicators for pregnant women sick-listed with PPGP ought to have been used, but these figures do not exist, and addressing these issues in more detail is beyond the scope of this article.

5. Conclusion

Previous studies have found that pregnancy-related health problems represent a significant economic burden for the society (Moran et al., 2020), but to the best of the author’s knowledge, no previous studies have attempted to estimate any type of economic burden due to PPGP, neither in Norway nor in other countries. One reason for this may be lack good data for prevalence. As illustrated by the large uncertainty around the estimates displayed in table 7, this was also a considerable hurdle here. However, the results should still be of interest to the research community as well as to stakeholders for at least two reasons.

First, even the minimum estimates, which were most likely downward biased, indicated that a significant share of women became temporarily work disabled due to PPGP during pregnancy. Only a small share of these became work disabled on a permanent basis, but they accounted for more than one third of all the person-years lost to PPGP in 2015 because the condition strikes fairly early in life, and thus, permanent work disability results in many years outside the workforce. Consequently, the results indicate that work disabling PPGP has severe consequences for the Norwegian society and should be considered a major public health problem. Second the results exhibit the uncertainty and illustrate the urgent need for better data. An important contribution in this respect would be to make more specific diagnostic categories for PPGP in WHO's diagnostic systems. Another important contribution would be to conduct large-scale surveys of representative samples of the whole population of pregnant women within a country.

The estimated economic burden should be viewed relative to a situation where no women become work disabled due to PPGP. At present, this is unrealistic as much is still unknown about effective treatment methods. However, as shown in the article, PPGP is a condition with low professional prestige met with little acceptance in the past, in Norway and elsewhere, and it has been found to be undertreated (Moran et al., 2020). Prioritising the condition higher is therefore likely to reduce prevalence. The cost estimates serve a point of departure of what Norwegian society could save in reduced job absenteeism by preventing and successfully treating PPGP.

These are not the only costs that could be saved, though. The estimates only reflect the economic burden of *paid* labour lost, but calculating the total economic burden of PPGP would require a complete cost of illness study, where i.a. also the costs of health and social services provided due to PPGP should be included (Jo, 2014). Ideally, it should also include the value of reduced unpaid domestic work. Estimation of costs like that is left for future research.

List of Abbreviations

AAP: work assessment allowance

ICD: International Classification of Diseases

ICPC: International Classification of Primary Care

FTE: Full-time equivalent

NAV: Norwegian Labour and Welfare Administration

PLBP: Pregnancy-related low back pain

PLPP: pregnancy-related lumbopelvic pain

PPGP: Pregnancy-related pelvic girdle pain

SSB: Statistics Norway

WHO: World Health Organisation

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