Disability life table by cause for insured workers in Brazil, 1999-2002

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Abstract

The main goal of this paper is to estimate a Disability Beneficiaries Life Table from the General Social Security Regime for Private Sector Workers (RGPS) by sex, age and disability cause in Brazil using multiple-decrement models. The results show that – in contradiction with the disability life tables used by the private sector – the male disability retirement hazard increases steadily until age 65 and after that it decreases. However, for females, these risks increase continuously up to the oldest age. More sex differentials show that, among women, the risk of disability retirement is larger due to circulatory diseases, musculoskeletal diseases and neoplasms. Among the men, mental disorders are the most responsible for an overweight in the number of pensioners, especially among the young and adult age groups. This paper contributes to a better understanding of work and disability, especially in the field of social security and retirement.

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1. Introduction

The Brazilian demographic transition process during the last half century caused expressive changes in the Brazilian population age structure (Carvalho, 2004). The first important change is characterized by a fast child mortality decline beginning in the 1940s. The direct consequence of this process of mortality decline was the increase in life expectancy (Prata, 1992; Ortiz, 2002). In a period of almost sixty years, the life expectancy of the country rose from 44 years in 1940 to 72 years in 2004 (Carvalho, 2004; IDB, 2005). In the most developed regions of the country it has been verified that there is an increase in the number of deaths by external causes and non-transmissible diseases, but a decrease in the number of deaths by transmissible diseases (Ferreira & Catiñeiras, 1996, 1998; Gawryszewski & Jorge, 2000; Nunes, 2004; Schramm et al, 2004). Moreover, fertility has followed a similar path of continuous decline. TFR (Total Fertility Rate) fell from 6.3 to 5.8 in 1970 and to 4.4 in 1980. After the end of the 1980s the reduction in the national TFR was more pronounced, achieving the value of 2.9 in 1991. Finally, in 2006, the TFR reached the below replacement level (Rios-Neto, 2005; IDB, 2007; Alves, 2008).

This demographic transition process has important implications to labor market and social security system due to the changes in the age structure. In the case of Brazil, in order to keep the social security system working, it is necessary to have an overwhelming number of taxpayers. In this way, the Brazilian demographic transition process, characterized by a fertility decline and increasing in life expectancy, causes a reduction in the number of future active population, together with population aging. Therefore, the amount of taxpayers decrease as the number of beneficiaries increases and the social security system becomes deficient (Brito, 2007).

The Brazilian social security system defines work disability as the incapacity to develop any kind of labor activity without the possibility of recovering or exercising any payment work activity (Brasil, 1999). In Brazil, the public social security system allows early retirement, and it also covers any income lost to all insured laborers and victims of permanent work disability due to illness or work injuries. This retirement benefit shall be granted to the employee, even if he or she does not have illness assistance[1] (Gomes, 2008).

State of work incapacity is verified by periodical medical evaluation. For the worker, the possibility of a health evaluation by his own trusted physician is permissible. In any case, there is no possibility to get retirement disability when the disease or injury was notified on the day of social security membership; however, there is an exception in the case of incapacity due to progression or aggravation of this disease or injury (Brasil, 1999). According to the regulation of Brazilian Social Security (1999), the benefit of retirement disability is granted for those who pay at least twelve months to the pension public system, this being the minimum time length of contribution until the pensioner starts to receive social retirement benefits.

For those who lost the benefit of retirement, and instead, renew their membership to RGPS, the right of retirement disability is given after four months of payment to the social security system. However, in two cases the benefit of retirement is independent of the time of

[1] The illness assistance is a benefit given in the cases of temporary incapacity to work, due to illness or injury that exceeds 15 days (Brazil, 1999).

contribution[2]. The first being when the retirement occupation disability is caused by work accident, and the second, when the employee falls victim to any specific illness or injury, according to the disease list of the Health Ministry and Social Security.

The last list released by the Portaria Interministerial n° 2.998, 23 August 2001 includes the following list of diseases: active tuberculosis, leprosy, mental alienation, malignant neoplasm, blindness, irreversible and disabling paralysis, serious cardiopathy, advanced state of the illness of Paget, Syndrome of the Acquired Immune Deficiency – AIDS, radiation contamination and serious liver diseases (Brasil, 1999). Since 1991 there is no change in this list.

According to the Anuários Estatísticos da Previdência Social (AEPS) the disabilities withdraw benefit can be classified into accidental or social security retirement. The main distinction among these two is that the retirement by accident occurs when the employee exercises his work activity inside the occupational environment or during transportation to and from work. Moreover, the accidental withdraw is independent of the number of former financial contributions to the RGPS, nonetheless, this benefit will be available once the worker has paid the minimum pension contribution established by law.

In the sense that this paper brings a better understanding and knowledge of the retirement benefit flows it serves as a pillar for public policy. The estimation of such retirement flows is based on the so-called "disability beneficiaries life tables". These tables contain the transition hazards from occupational state to permanent disability withdraw. Concerning the construction of these tables, it is remarkable that population age composition is highly correlated with the transition hazards (Gomes, 2008). The knowledge of these transition hazards of retirement, in relation to the disease and injury, can serve as guide for policy makers once they can apply this information in the labor environment to develop work and health prevention policies. This information can also be applied to forecast the costs of early labor market exits, since earlier withdraws generally create more costs for the social security system (Ribeiro, 2006). Thus, our main goal is to build up **disability beneficiary life tables** by sex, age and disability causes. Theses tables consider only the laborers who are insured by the public social security regime, RGPS, during the period of January 1st, 1999 to December 31st, 2002. The main methodologies applied in this paper are multi-decrement life tables. These tables allow the opportunity to study the effects of every disability cause, separately or together, and the resultant effect on the general retirement pattern. We will also present an exercise based on the reduction of incidence rates of a number of morbidity causes. The considered causes are all susceptible to reduction.

It is important to say that these tables represent only the disability retirement experience of each individual. They do not include the entire population of disabled individuals. Therefore, these tables include only the pensioners who retire due to some disability. All other beneficiaries are not considered in the analysis. Also not included are other beneficiaries who receive benefits from continuous payment[3] since the Ministry of Social Security (INSS) does

[2] The accidents of any nature or cause are defined as being those of traumatic origin and exposition to exogenous agents (physical, chemical and biological) that they cause bodily injuries or functional disturbance, resulting in death or permanent or temporary loss of the capacity to work (Brazil, 1999 and Ribeiro, 2006).

[3] Benefits from continuous payment are characterized by continuous monthly payments, until some cause (for example death) cease it. In this category of retirement are pensions for death, lifetime monthly incomes, allowances of permanence in service, the wage-family and maternity, etcs (AEPS 2005, 2007).

not allow the change of these benefits in disability retirement. Furthermore, those who chose other pension system are discarded from the analyses. It is important to say that the risks of retirement are competitive, since there are different kinds of benefits offered by the security system. For this reason the values of the disability retirement hazards may be affected by these competitive benefits. In order to get better estimates we try to adjust the disability life table considering only the beneficiaries from the RGPS (Gomes, 2008).

2. Data and methods

2.1 Data set and population of study

The data is built up by administrative records gathered by Technological Enterprises and Social Security Information (DATAPREV) and combined with the information of beneficiaries given by the Previdência Social do Cadastro Nacional de Informações Sociais (CNIS). The mortality tables, by sex and age, are estimated according to data from the Departamento de População e Indicadores Sociais (DEPIS) and Instituto Brasileiro de Geografia e Estatística (IBGE).

The period of analyses is from 1999 to 2002. It is a good period since it represents recent experiences of the retirees. At the same time, it is also a short period which reduces the effects of changes in the benefits rules[4] on the transitions from activity to disability state. For the estimation of the transition rates, both rural and urban beneficiaries are considered. However, the groups of special retirees[5] are discarded once these pensioners make up part of the crude rural production, therefore they may be underestimated. For the most part these workers receive social security benefit after a minimum time of exercise in some rural occupation. For these rural workers, the social security system guarantees health assistance or disability retirement in the value of minimum country wage (Brasil, 1999; AEPS 2005, 2007). Depending on which beneficiary group is considered, the transition rates will be biased due to a lack of information about the exact number of employees who belongs to this group (Gomes, 2008).

2.2 classifications of disabilities according to the ICD 10

In accordance with the revised 10th International Classification of Diseases (ICD 10) the disability retirement tables for the period of 1999-2002 were established. Among the disability withdraws in 1999, barely 20% were classified following the ICD 9. For the following periods the classification of diseases by ICD 10 was applied. For this reason, the analyses of the retirement tables did not go to more disaggregated levels of illness, according to the ICD 10, since it is expected that more detailed levels of analyses might bring incorrect classifications (Ribeiro, 2006).

The data was processed following the footsteps of the previous work of Ribeiro (2006). In this way, the structure of disability causes included information from the initial physician visit until the last physician visit. If information from the first medical visit was not available,

[4] The changes in benefit rules came after the Constitutional Emend n° 20, from 16 December 1998 (Brasil, 1998).

[5] The special retirees are classified in: the producer, the partner, the sharecropper and the agricultural leaseholder, the artisan fisherman who exercise these activities individually or in familiar economy regime, receiving eventual assistance from a third party. Also it is taken to account the respective spouses, friends and children older than 16 years, since they work with the respective familiar group (AEPS 2005, 2007).

such that a comparison could not be made, then only information from the last medical record was considered.

During the classification of diseases we took into account two important changes that occurred among the 9th and 10th ICD. The first change concerns the split of the single chapter on nervous and sensory system diseases from the former ICD 9 into three new chapters in the ICD 10. Chapter VI now contains diseases of the nervous system, chapter VII diseases of the eye and adnexa, and chapter VIII contains information on the diseases of the ear and mastoid process. The second change concerns Chapters I, III and IV from ICD 10. In the former classification the immune deficiency disorders, including HIV infection, belong to Chapter III (endocrine glands, nutrition and metabolism diseases, and disorders involving the immune mechanism). In the new classification of ICD 10 HIV infection became part of other chapters, namely Chapter I detailing certain infectious and parasitic diseases, and Chapter III which covers diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism. The endocrines, nutritionals and metabolic diseases have been placed in a separate chapter in ICD 10 (Grassi and Laurenti, 1998). Furthermore, the retirement disability causes from Chapter VI in ICD 9 have been divided into other chapters in the ICD 10.

To facilitate construction of the transition tables, we introduce the category of "non-information", gathering all unexpected disability retirement causes. For example, the causes of disability classified in Chapter XV concerning pregnancy, childbirth and puerperium and in Chapter XVI covering certain conditions originating in the perinatal period and Chapter XX detailing external causes of morbidity and mortality were placed into the category "non-information" because there were no retirement benefits concerning these causes (see table 1). We also create the category of "others" gathering less representative disability information. The category contains the following chapters and diseases: Chapter III - diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism, Chapter VIII - diseases of the ear and mastoid process, Chapter XI - diseases of the digestive system, Chapter XII - diseases of the skin and subcutaneous tissue, Chapter XVII - congenital malformations, deformations and chromosomal abnormalities, Chapter XVIII - symptoms, signs and abnormal clinical and laboratory findings not elsewhere classified and Chapter XXI - factors influencing health status and contact with health services (Gomes, 2008).

2.3 Decrement life tables: disability retirement life tables according to morbidity causes

In order to build up the life table, we assumed that the workers are at risk of labor market exit due to different morbidity causes. In this context of multiple events, each singular cause of retirement can be regarded as decrement or transition rates. We also assume that, at the time of retirement, every possible cause of morbidity could be experienced by the retiree (Seal, 1977; Winklevoss, 1993).

Since we know all transition states the next step is to estimate the whole life table and the retirement hazards. Thus, disability retirement hazards by a particular case are estimated, as well as the gain in years after a singular morbidity cause is discarded (Namboodiri and Suchindran, 1987). The estimates are obtained via the following steps:

- *First step*: estimate the disability retirement life table for all morbidity causes. The basic idea behind it is to estimate the disability retirement rates according to all morbidity causes – ${}_{n}\mathrm{r}_{x}$ – between the ages *x* and *x*+*n*, in the time interval *t*:

$$ {}_{n}r_{x,+} = \left(\frac{{}_{n}I_{x,+}}{{}_{n}L_{x}^{aa}} \right) \tag{1} $$

Where:

${}_{n}\mathrm{I}_{x,+}$: Number of pensioners among the ages *x* and *x*+*n*, at the observation period, according to the all causes C_{+};

${}_{n}\mathrm{L}_{\mathrm{x}}^{\mathrm{aa}}$: Number of person-years exposed to the risk disability withdraw in ages *x* and *x*+*n*, during the observation period.

The number of permanent disabled pensioners is estimated by the number of social benefits given during the period between January 1st, 1999 and December 31st, 2002 regarding the time of exposure to the risk of retirement disability (see Gomes, 2008).

- *Second Step*: after estimating the total numbers of retirees this amount is distributed into distinguished disability causes – C_{α} – in each age. It is done considering the proportional distribution of the number of retirees by each observed morbidity reason:

$$ {}_{n}i_{x,\alpha} = {}_{n}i_{x} \times \left(\frac{{}_{n}I_{x,\alpha}}{{}_{n}I_{x,+}} \right) \tag{2} $$

Where:

${}_{n}\mathrm{i}_{x,\alpha}$: Number of pensioners by each disability cause C_{α}, between the ages *x* and *x*+*n*, in the period of study;

${}_{n}\mathrm{i}_{x}$: Number of pensioners in the table considering all combined disability causes C_{+}, between the ages *x* and *x*+*n* and in the study period;

${}_{n}\mathrm{I}_{x,\alpha}$: Number of observed pensioners, between the ages *x* and *x*+*n* and in the study period according to cause C_{α};

${}_{n}\mathrm{I}_{x,+}$: Number of observed pensioners, between the ages *x* and *x*+*n* and in the study period, by cause C_{α} according to cause C_{+};

- *Step three*: the ratio of ${}_{n}\mathrm{i}_{x,\alpha}$ and the survive function l_{x}. We estimate the retirement hazards according to each morbidity cause. The assumption behind rationality is that the whole population at risk to survive until exact age *x* can retire due to any disability cause C_{α} since each cause of morbidity can be experienced by the pensioner (Namboodiri and Suchindran, 1987). These estimated hazards are then so-called "crude disability retirement hazards according to morbidity cause".

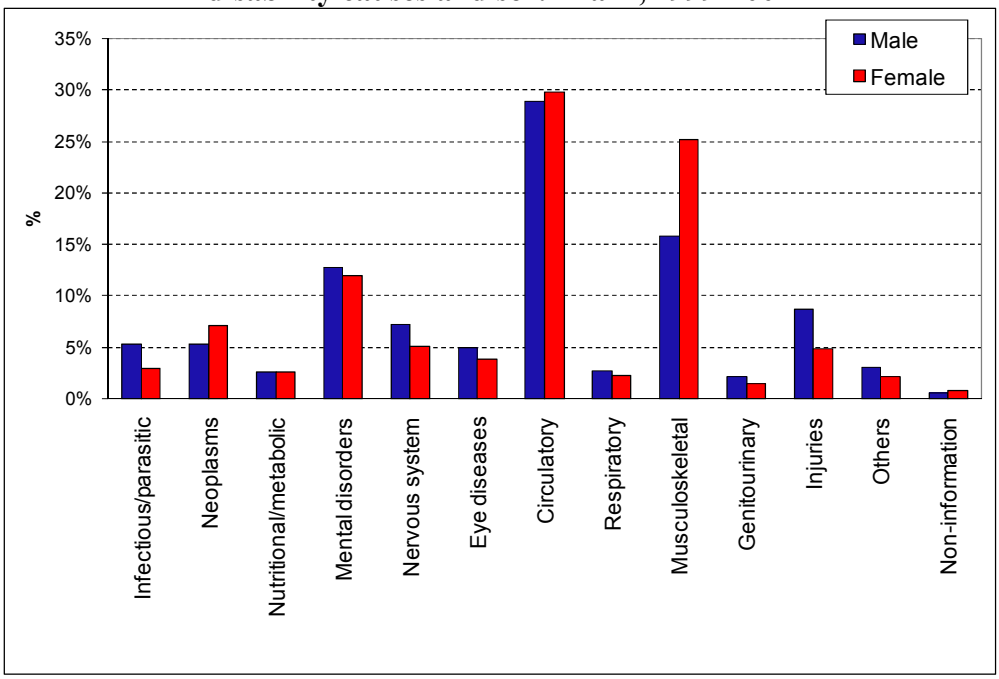
It is important to note, however, the RGPS beneficiary is at risk of disability withdraw at the commencement of his membership. This can happen as long as he is aged 15 (while the employee is a trainee) or aged 17 and above for the other beneficiaries. Although, in this paper we consider just those who retire between the age limits of 20 and 70 years old. The choice of 20 as the minimum age was due to the small number of pensioners below that age during the observation period. The upper limit was chosen based on the the same idea proposed by Ribeiro (2006). We consider the minimum age for retirement as the highest age limit, however, the population in our sample contains rural and urban retirees, and these two population groups have distinguished ages to retire. Moreover, we verified an overweight in the number of pensioners after the age of 60. For that reason, we found it reliable to consider age 70 as a consistent upper limit, although after this age we verify a small number of labor market exits - barely 1.4% of all retirement benefits. Once the retirement probabilities were estimated the next step was to build up the disability life table by sex and age for the period of analysis.

3. Results

3.1 Generally characteristics of disability retirement according to disease causes between 1999-2002

Figure 1 shows the distribution of the disability labor market exits by sex. As we can see, for both sexes, circulatory diseases were the most responsible for an overwhelming number of retirement benefits, corresponding to 29.2% of the total amount of retirees. These diseases are followed by musculoskeletal diseases and mental disorder, representing 19.5% and 12.4% of the total number of pensioners respectively. In the United States during the period 1998-2002, these diseases were also the most responsible in granting retirement benefits (Zayatz, 2005). Among the sexes, men have higher percentages of injuries than women; however, it is clearly visible that musculoskeletal diseases affect a larger percentage of women than men.

Figure 1 – Relative distribution of the disability beneficiaries from RGPS according to disability causes and sex. Brazil, 1999-2002

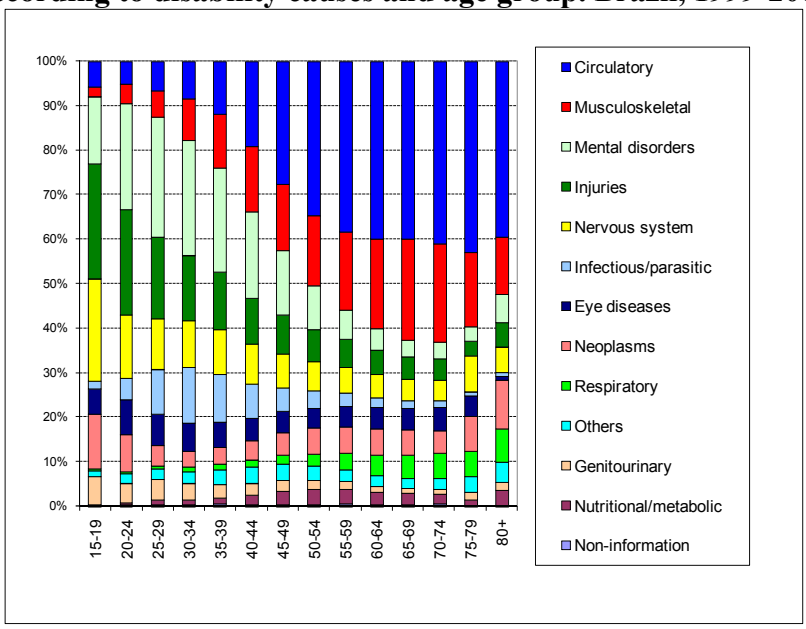


Source: MPS/DATAPREV.

Zayatz (1999, 2005) makes clear that the distribution of retirement benefits, according to disability causes, are highly correlated with the age of the pensioner. This may explain the different retirement distribution verified among the sexes.

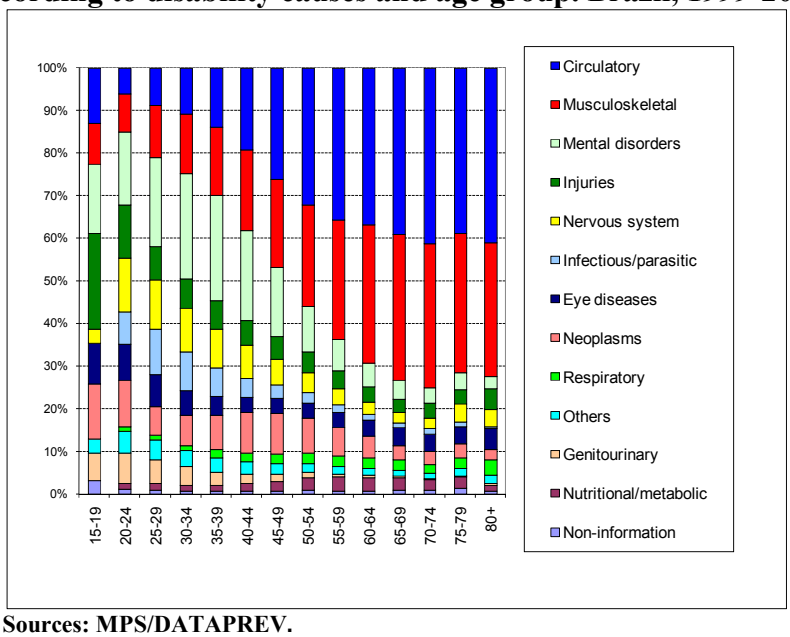
In the next graphs 2 and 3, we observe the change in disability causes with age. Mental disorders and nervous system diseases tend to decrease with age. Other diseases like circulatory and musculoskeletal diseases are more common mainly among women. Ribeiro (2006) verifies that the health conditions of a laborer tend to deteriorate once the individual becomes older. As a direct consequence we expect that the number of other disabilities increase with the age of the employee.

Figure 2 – Male Relative distribution of the disability beneficiaries from RGPS according to disability causes and age group. Brazil, 1999-2002



Sources: MPS/DATAPREV.

Figure 3 – Female Relative distribution of the disability beneficiaries from RGPS according to disability causes and age group. Brazil, 1999-2002



Sources: MPS/DATAPREV.

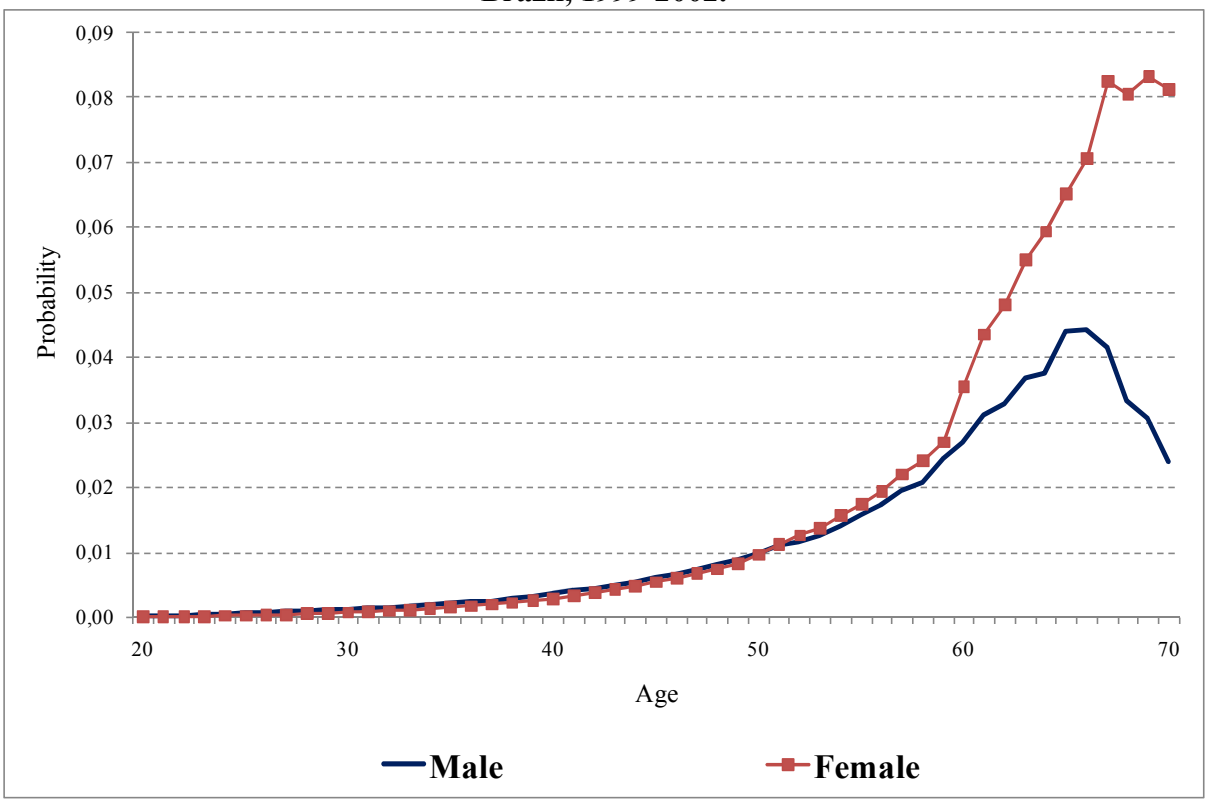
The next section presents the crude hazards of retirement according to morbidity causes, sex and age for the period of analysis.

3.2 The intrinsic pattern in the life tables

The tables 1 and 2 show crude pension hazards. It is important to note that in the construction of these tables we consider only the beneficiaries from the RGPS. Once they are employees granted with other kinds of pension benefits or members of other retirement system they are dropped from our analysis.

Generally, the male retirement hazards by morbidity cause (see TAB. 1 and FIGURE 4) increases steadily until age 65 and after that it decreases, showing high values until the age of 70. For females, however, these risks increase continuously up to the oldest age (see TAB. 2 and FIGURE 4). The decline in the male retirement hazards after age 65 may lead to different conclusions. An initial conclusion is that among all retirees there is some kind of selective group with better health conditions and with higher risks to stay active. A second conclusion implies that fragile retirees acquire other sorts of benefits or they simply cannot financially contribute to RGPS and keep their social benefit. Thus, as we can see, there are still a larger number of labor market exits, even after the upper age limit to retire. This can be explained by the presence of female employees, who did not fulfill the prerequisites to retire until the minimum age of pension. In this way they still belong to the risk group of disability retirement for a longer period.

Figure 4 – Crude disability retirement hazards according to sex and age. Brazil, 1999-2002.



Source: TAB. 1 e TAB. 2.

The analyses of table 1 and 2 show that, for both sexes, the risk of disability retirement is larger due to circulatory and musculoskeletal diseases. Among women the crude disability retirement risk due to neoplasm is somewhat larger than among their male counterparts. Among the latter, mental health disorders form the most frequent reason for premature retirement for an overwhelming number of pensioners, especially within the young-adult age groups. Fig 3 also illustrates that, as the employee's age increases, injuries, mental disorders and nervous system illnesses tend to decrease. However, other illnesses such as circulatory and musculoskeletal diseases become more common, especially among women.

It is also important to mention that the knowledge of the disability retirement hazards by morbidity causes creates the opportunity to develop new policies of hazard prevention and to promote a better work environment. With this in mind, the next section of this work presents an exercise based on the reduction of incidence rates of a number of morbidity causes. The considered causes are all susceptible to reduction.

Table 1. Male crude disability retirement hazards according to health cause and age. Brazil, 1999-2002.

Age	Crude hazards													
	Infectious	Neoplasms	Nutritional/metabolic	Mental disorders	Nervous system	Eye diseases	Circulatory	Respiratory	Musculoskeletal	Genitourinary	Injuries	Others	Non-information	Total
20	0,00000	0,00001	0,00000	0,00002	0,00001	0,00001	0,00000	0,00000	0,00000	0,00000	0,00002	0,00000	0,00000	0,00009
21	0,00001	0,00002	0,00000	0,00003	0,00002	0,00001	0,00001	0,00000	0,00001	0,00001	0,00004	0,00000	0,00000	0,00015
22	0,00001	0,00002	0,00000	0,00004	0,00003	0,00002	0,00001	0,00000	0,00001	0,00001	0,00004	0,00000	0,00001	0,00020
23	0,00002	0,00002	0,00000	0,00007	0,00004	0,00003	0,00002	0,00000	0,00002	0,00002	0,00006	0,00000	0,00001	0,00030
24	0,00003	0,00003	0,00000	0,00009	0,00004	0,00003	0,00002	0,00000	0,00002	0,00002	0,00007	0,00000	0,00001	0,00038
25	0,00004	0,00003	0,00001	0,00014	0,00006	0,00003	0,00004	0,00001	0,00003	0,00003	0,00009	0,00000	0,00001	0,00051
26	0,00005	0,00003	0,00001	0,00015	0,00007	0,00004	0,00005	0,00000	0,00004	0,00003	0,00010	0,00000	0,00002	0,00059
27	0,00008	0,00004	0,00001	0,00018	0,00008	0,00005	0,00006	0,00000	0,00006	0,00004	0,00012	0,00000	0,00002	0,00074
28	0,00009	0,00004	0,00001	0,00021	0,00009	0,00006	0,00006	0,00001	0,00006	0,00004	0,00012	0,00000	0,00003	0,00084
29	0,00012	0,00005	0,00001	0,00024	0,00011	0,00007	0,00007	0,00001	0,00008	0,00005	0,00014	0,00001	0,00003	0,00098
30	0,00012	0,00005	0,00001	0,00029	0,00013	0,00008	0,00009	0,00001	0,00011	0,00005	0,00015	0,00001	0,00003	0,00113
31	0,00016	0,00006	0,00001	0,00034	0,00015	0,00008	0,00011	0,00001	0,00013	0,00006	0,00017	0,00001	0,00004	0,00132
32	0,00017	0,00007	0,00001	0,00036	0,00014	0,00009	0,00012	0,00001	0,00015	0,00006	0,00018	0,00001	0,00005	0,00143
33	0,00018	0,00007	0,00002	0,00041	0,00016	0,00010	0,00016	0,00002	0,00018	0,00006	0,00020	0,00001	0,00005	0,00164
34	0,00020	0,00009	0,00002	0,00046	0,00018	0,00011	0,00020	0,00002	0,00022	0,00006	0,00020	0,00001	0,00005	0,00181
35	0,00022	0,00011	0,00003	0,00049	0,00021	0,00012	0,00021	0,00002	0,00025	0,00008	0,00024	0,00001	0,00006	0,00205
36	0,00024	0,00010	0,00003	0,00054	0,00022	0,00011	0,00027	0,00003	0,00027	0,00007	0,00025	0,00002	0,00007	0,00223
37	0,00024	0,00012	0,00003	0,00058	0,00022	0,00013	0,00030	0,00003	0,00032	0,00007	0,00026	0,00001	0,00008	0,00241
38	0,00024	0,00015	0,00004	0,00065	0,00026	0,00014	0,00036	0,00004	0,00039	0,00008	0,00029	0,00002	0,00009	0,00275
39	0,00024	0,00017	0,00005	0,00072	0,00030	0,00015	0,00045	0,00005	0,00046	0,00009	0,00031	0,00002	0,00011	0,00312
40	0,00027	0,00020	0,00006	0,00076	0,00032	0,00016	0,00056	0,00006	0,00054	0,00010	0,00033	0,00002	0,00011	0,00350
41	0,00030	0,00023	0,00008	0,00088	0,00035	0,00018	0,00070	0,00006	0,00065	0,00009	0,00036	0,00002	0,00014	0,00404
42	0,00028	0,00027	0,00008	0,00087	0,00036	0,00020	0,00085	0,00008	0,00068	0,00012	0,00040	0,00002	0,00014	0,00435
43	0,00030	0,00030	0,00011	0,00091	0,00038	0,00022	0,00099	0,00008	0,00082	0,00013	0,00039	0,00003	0,00016	0,00482
44	0,00030	0,00037	0,00012	0,00098	0,00044	0,00024	0,00117	0,00010	0,00089	0,00013	0,00045	0,00003	0,00018	0,00539
45	0,00030	0,00040	0,00015	0,00102	0,00043	0,00026	0,00147	0,00012	0,00098	0,00014	0,00048	0,00004	0,00021	0,00600
46	0,00032	0,00044	0,00017	0,00107	0,00050	0,00030	0,00171	0,00013	0,00107	0,00014	0,00053	0,00004	0,00022	0,00664
47	0,00031	0,00047	0,00019	0,00111	0,00050	0,00030	0,00199	0,00014	0,00131	0,00016	0,00057	0,00003	0,00023	0,00731
48	0,00034	0,00054	0,00023	0,00113	0,00054	0,00034	0,00224	0,00018	0,00130	0,00017	0,00058	0,00005	0,00028	0,00794
49	0,00035	0,00060	0,00026	0,00111	0,00056	0,00037	0,00258	0,00019	0,00160	0,00018	0,00064	0,00005	0,00029	0,00878
50	0,00035	0,00068	0,00032	0,00115	0,00064	0,00041	0,00304	0,00020	0,00169	0,00020	0,00066	0,00006	0,00031	0,00969
51	0,00038	0,00076	0,00035	0,00118	0,00067	0,00044	0,00361	0,00026	0,00198	0,00020	0,00071	0,00006	0,00032	0,01092
52	0,00038	0,00080	0,00037	0,00118	0,00067	0,00047	0,00382	0,00030	0,00217	0,00019	0,00076	0,00007	0,00031	0,01149
53	0,00040	0,00081	0,00043	0,00117	0,00067	0,00050	0,00443	0,00033	0,00247	0,00019	0,00074	0,00010	0,00034	0,01259
54	0,00041	0,00094	0,00045	0,00123	0,00072	0,00057	0,00497	0,00039	0,00293	0,00021	0,00081	0,00010	0,00035	0,01408
55	0,00046	0,00099	0,00053	0,00129	0,00082	0,00065	0,00567	0,00047	0,00329	0,00022	0,00088	0,00013	0,00041	0,01581
56	0,00041	0,00111	0,00059	0,00128	0,00082	0,00074	0,00635	0,00048	0,00369	0,00024	0,00092	0,00012	0,00039	0,01713
57	0,00049	0,00121	0,00066	0,00133	0,00092	0,00083	0,00721	0,00061	0,00421	0,00026	0,00105	0,00012	0,00045	0,01934
58	0,00052	0,00129	0,00068	0,00130	0,00097	0,00078	0,00783	0,00065	0,00480	0,00023	0,00113	0,00013	0,00043	0,02072
59	0,00053	0,00148	0,00077	0,00152	0,00111	0,00101	0,00927	0,00082	0,00575	0,00025	0,00126	0,00017	0,00055	0,02447
60	0,00059	0,00167	0,00084	0,00153	0,00109	0,00116	0,01030	0,00090	0,00643	0,00025	0,00135	0,00017	0,00058	0,02686
61	0,00067	0,00168	0,00103	0,00167	0,00137	0,00126	0,01197	0,00110	0,00777	0,00028	0,00146	0,00017	0,00062	0,03106
62	0,00064	0,00183	0,00099	0,00171	0,00140	0,00144	0,01247	0,00127	0,00850	0,00028	0,00155	0,00025	0,00061	0,03295
63	0,00060	0,00192	0,00101	0,00175	0,00157	0,00161	0,01445	0,00134	0,00959	0,00028	0,00164	0,00023	0,00074	0,03673
64	0,00060	0,00215	0,00100	0,00168	0,00146	0,00154	0,01464	0,00154	0,00984	0,00036	0,00163	0,00019	0,00087	0,03750
65	0,00070	0,00226	0,00117	0,00190	0,00179	0,00202	0,01733	0,00181	0,01134	0,00036	0,00212	0,00028	0,00087	0,04395
66	0,00065	0,00213	0,00123	0,00172	0,00157	0,00180	0,01732	0,00165	0,01266	0,00037	0,00197	0,00029	0,00091	0,04426
67	0,00064	0,00163	0,00108	0,00171	0,00151	0,00187	0,01632	0,00166	0,01211	0,00023	0,00164	0,00031	0,00079	0,04150
68	0,00045	0,00149	0,00091	0,00145	0,00113	0,00159	0,01359	0,00135	0,00926	0,00024	0,00108	0,00023	0,00061	0,03338
69	0,00035	0,00131	0,00078	0,00113	0,00113	0,00155	0,01224	0,00120	0,00892	0,00023	0,00107	0,00022	0,00049	0,03062
70	0,00028	0,00081	0,00056	0,00077	0,00084	0,00106	0,00988	0,00094	0,00705	0,00017	0,00108	0,00014	0,00044	0,02401

Source: MPS/DATAPREV.

Table 2. Female crude disability retirement hazards according to health cause and age. Brazil, 01/01/1999 to 31/12/2002.

Age	Crude hazards													
	Infectious	Neoplasms	Nutritional/metabolic	Mental disorders	Nervous system	Eye diseases	Circulatory	Respiratory	Musculoskeletal	Genitourinary	Injuries	Others	Non-information	Total
20	0,00000	0,00001	0,00000	0,00001	0,00001	0,00000	0,00000	0,00000	0,00000	0,00000	0,00001	0,00000	0,00000	0,00005
21	0,00000	0,00001	0,00000	0,00001	0,00001	0,00000	0,00000	0,00000	0,00000	0,00000	0,00001	0,00000	0,00000	0,00005
22	0,00000	0,00001	0,00000	0,00002	0,00002	0,00001	0,00000	0,00000	0,00000	0,00001	0,00002	0,00000	0,00000	0,00010
23	0,00001	0,00001	0,00000	0,00003	0,00002	0,00001	0,00001	0,00000	0,00001	0,00001	0,00003	0,00000	0,00000	0,00014
24	0,00001	0,00001	0,00000	0,00005	0,00002	0,00001	0,00001	0,00000	0,00001	0,00001	0,00004	0,00000	0,00000	0,00019
25	0,00002	0,00001	0,00000	0,00006	0,00003	0,00002	0,00002	0,00000	0,00002	0,00001	0,00004	0,00000	0,00001	0,00024
26	0,00003	0,00002	0,00000	0,00008	0,00004	0,00002	0,00003	0,00000	0,00002	0,00002	0,00006	0,00000	0,00001	0,00034
27	0,00004	0,00002	0,00000	0,00010	0,00005	0,00003	0,00003	0,00000	0,00003	0,00002	0,00006	0,00000	0,00001	0,00040
28	0,00006	0,00003	0,00000	0,00013	0,00006	0,00004	0,00004	0,00000	0,00004	0,00002	0,00007	0,00000	0,00002	0,00051
29	0,00007	0,00003	0,00001	0,00015	0,00006	0,00004	0,00004	0,00001	0,00005	0,00003	0,00009	0,00000	0,00002	0,00059
30	0,00008	0,00003	0,00001	0,00019	0,00008	0,00005	0,00006	0,00001	0,00007	0,00003	0,00010	0,00000	0,00002	0,00073
31	0,00010	0,00004	0,00001	0,00023	0,00010	0,00005	0,00007	0,00001	0,00008	0,00004	0,00011	0,00001	0,00003	0,00088
32	0,00012	0,00005	0,00001	0,00025	0,00010	0,00006	0,00008	0,00001	0,00011	0,00004	0,00012	0,00001	0,00003	0,00100
33	0,00013	0,00005	0,00002	0,00029	0,00011	0,00007	0,00011	0,00001	0,00013	0,00004	0,00014	0,00001	0,00004	0,00116
34	0,00014	0,00006	0,00001	0,00032	0,00013	0,00008	0,00014	0,00002	0,00015	0,00004	0,00014	0,00001	0,00004	0,00127
35	0,00016	0,00008	0,00002	0,00036	0,00015	0,00009	0,00016	0,00002	0,00018	0,00006	0,00018	0,00001	0,00005	0,00151
36	0,00018	0,00008	0,00002	0,00042	0,00017	0,00009	0,00021	0,00002	0,00021	0,00006	0,00019	0,00001	0,00006	0,00171
37	0,00019	0,00010	0,00003	0,00047	0,00018	0,00010	0,00024	0,00003	0,00026	0,00006	0,00021	0,00001	0,00006	0,00194
38	0,00019	0,00012	0,00003	0,00053	0,00021	0,00012	0,00029	0,00003	0,00032	0,00006	0,00023	0,00002	0,00007	0,00222
39	0,00020	0,00014	0,00004	0,00059	0,00025	0,00012	0,00037	0,00004	0,00038	0,00008	0,00025	0,00002	0,00009	0,00258
40	0,00022	0,00016	0,00005	0,00062	0,00026	0,00013	0,00046	0,00005	0,00044	0,00008	0,00027	0,00002	0,00009	0,00286
41	0,00024	0,00019	0,00007	0,00072	0,00029	0,00015	0,00058	0,00005	0,00053	0,00007	0,00029	0,00002	0,00011	0,00332
42	0,00024	0,00023	0,00007	0,00074	0,00031	0,00017	0,00072	0,00007	0,00059	0,00010	0,00034	0,00002	0,00012	0,00372
43	0,00027	0,00027	0,00010	0,00083	0,00035	0,00020	0,00089	0,00007	0,00074	0,00012	0,00036	0,00002	0,00015	0,00438
44	0,00026	0,00032	0,00010	0,00086	0,00039	0,00021	0,00103	0,00009	0,00078	0,00012	0,00039	0,00003	0,00016	0,00475
45	0,00027	0,00035	0,00013	0,00092	0,00039	0,00023	0,00132	0,00010	0,00088	0,00012	0,00043	0,00004	0,00019	0,00538
46	0,00028	0,00039	0,00015	0,00096	0,00045	0,00027	0,00154	0,00012	0,00096	0,00013	0,00048	0,00004	0,00020	0,00595
47	0,00029	0,00044	0,00018	0,00104	0,00047	0,00028	0,00186	0,00013	0,00122	0,00015	0,00053	0,00003	0,00022	0,00684
48	0,00032	0,00051	0,00022	0,00106	0,00051	0,00032	0,00209	0,00017	0,00122	0,00016	0,00054	0,00004	0,00027	0,00742
49	0,00033	0,00057	0,00024	0,00105	0,00053	0,00035	0,00244	0,00018	0,00151	0,00017	0,00060	0,00005	0,00027	0,00828
50	0,00035	0,00067	0,00031	0,00114	0,00063	0,00041	0,00303	0,00020	0,00169	0,00020	0,00065	0,00006	0,00031	0,00966
51	0,00039	0,00079	0,00036	0,00122	0,00069	0,00045	0,00372	0,00027	0,00204	0,00020	0,00073	0,00007	0,00033	0,01127
52	0,00042	0,00088	0,00041	0,00130	0,00073	0,00051	0,00419	0,00033	0,00238	0,00021	0,00083	0,00008	0,00034	0,01260
53	0,00044	0,00089	0,00047	0,00128	0,00073	0,00055	0,00485	0,00037	0,00270	0,00021	0,00081	0,00011	0,00037	0,01378
54	0,00046	0,00105	0,00051	0,00137	0,00081	0,00063	0,00555	0,00043	0,00327	0,00023	0,00091	0,00012	0,00039	0,01571
55	0,00050	0,00109	0,00059	0,00142	0,00090	0,00072	0,00623	0,00051	0,00361	0,00024	0,00097	0,00014	0,00045	0,01738
56	0,00047	0,00126	0,00067	0,00145	0,00093	0,00084	0,00721	0,00054	0,00419	0,00027	0,00104	0,00013	0,00044	0,01945
57	0,00056	0,00138	0,00076	0,00151	0,00104	0,00095	0,00821	0,00069	0,00479	0,00029	0,00119	0,00014	0,00051	0,02202
58	0,00061	0,00150	0,00079	0,00151	0,00112	0,00091	0,00909	0,00075	0,00558	0,00026	0,00131	0,00015	0,00050	0,02408
59	0,00058	0,00163	0,00084	0,00167	0,00123	0,00111	0,01022	0,00091	0,00633	0,00027	0,00139	0,00018	0,00060	0,02698
60	0,00078	0,00220	0,00110	0,00202	0,00144	0,00153	0,01360	0,00119	0,00850	0,00034	0,00178	0,00022	0,00076	0,03546
61	0,00094	0,00236	0,00145	0,00234	0,00192	0,00177	0,01678	0,00154	0,01089	0,00040	0,00205	0,00024	0,00086	0,04354
62	0,00093	0,00267	0,00145	0,00249	0,00205	0,00210	0,01821	0,00186	0,01242	0,00041	0,00226	0,00037	0,00089	0,04811
63	0,00090	0,00288	0,00152	0,00262	0,00235	0,00242	0,02167	0,00201	0,01438	0,00042	0,00246	0,00034	0,00112	0,05509
64	0,00095	0,00340	0,00158	0,00266	0,00231	0,00244	0,02316	0,00243	0,01558	0,00057	0,00258	0,00030	0,00137	0,05934
65	0,00103	0,00336	0,00173	0,00282	0,00266	0,00300	0,02574	0,00269	0,01684	0,00054	0,00315	0,00041	0,00129	0,06528
66	0,00103	0,00340	0,00196	0,00274	0,00251	0,00288	0,02762	0,00264	0,02018	0,00058	0,00314	0,00046	0,00145	0,07058
67	0,00127	0,00324	0,00214	0,00340	0,00300	0,00372	0,03244	0,00330	0,02408	0,00046	0,00327	0,00061	0,00157	0,08250
68	0,00108	0,00361	0,00221	0,00350	0,00272	0,00383	0,03282	0,00326	0,02237	0,00057	0,00262	0,00056	0,00147	0,08062
69	0,00095	0,00356	0,00213	0,00309	0,00309	0,00420	0,03331	0,00325	0,02426	0,00062	0,00290	0,00060	0,00135	0,08331
70	0,00095	0,00274	0,00190	0,00260	0,00285	0,00358	0,03342	0,00317	0,02385	0,00057	0,00366	0,00046	0,00149	0,08123

Source: MPS/DATAPREV.

3.3 Simulations: estimating the number of disability retirees after the reduction of certain disability retirement cause

This section is presented in a few exercises of which the goal is to reduce the effect of a number of disability causes, considered susceptible to reduction. The reduction is established according to the incidence rates, by age group, of each cause. The exercises are also based on the results of previous studies. In this way, it is distinguished for each morbidity cause the highest risk group. The objective here is to show the possible gains in the number of tax payers, after stimuli through public policies to reduce the number of disability retirees.

Through simulations, it can be considered that the illnesses susceptible to reduction and with high incidence values are consistent according to FIG. 3. Next, we establish a scenario of reduction gathering all the reductions. For this exercise, the following causes are taken into account: musculoskeletal disease, injuries and mental illnesses. For the cutback, two scenarios of reduction are considered: one with 25% reduction and another with 50% of incidence decrease; both in the age groups of highest risk.

For this exercise, the cohort studies are the most reliable way to estimate incidence rates. However, it is generally too expensive and time-consuming. For these particular reasons, the data containing incidence information – especially for mental disorders – is very scarce; making certain other analysis more difficult, such as the knowledge of morbidity incidence rates changing in time.

3.3.1 The injuries caused by musculoskeletal disorders

Musculoskeletal disorders (MSDs) are part of a controversial occupational disease group, being the cause of debate among employers, employees and work unions. Since they can barely be correctly classified due to the great array of musculoskeletal illnesses causes, they are also responsible for high social security costs. In the United States, for example, the costs with work withdrawal have reached the yearly value of US$ 2.1 billion. The productivity costs are even higher, reaching yearly values of US$ 100 million. Concerning all the work exits, for each 100 withdrawals, 65 are due to MSDs (Costa, 2000).

In 1997 in Brazil, according to the Instituto Nacional do Seguro Social (INSS), there were 36.648 occurrences of occupational exits registered. The majority of these cases were due to the MSDs. In 2005, according to INSS and the chapter of ICD, the most incidences of these diseases are fist or hand wounds (S61), fist or hand injuries (S62), and superficial wounds in the fist and the hand (S60), with respectively 13.8%, 6.9% and 5.5% of the total. However, the MSDs are the leading group of diseases responsible for work exits, with high numbers of synovitis and tenosynovitis (M65), shoulder injuries, back pain, with 24,3%, 13,7% and 7,5% of the total exits (Carvalho, 2008).

The MSDs symptoms are generally characterized by muscle dysfunction, affecting also the joints, tendons, nerves and ligaments, causing chronic pain in the neck, shoulders and upper limbs (Costa, 2000).

In Brazil, the MSDs start to gain importance in the 1980s, once the work unions have observed frequent employees claims concerning some musculoskeletal disorders. In 1987, the social security system (INSS) recognized the Work-Related Upper Limb Disorder (WRULD) as a common type of MSDs, the group of disease which can also guarantee retirement benefits. The INSS rapports, in 1997, considers the WRULD as the most prevalent occupational disease; affecting mainly the active working population between age 20 to 40 years (Walsh et al., 2004). It is important to say that the MSDs related to work can cause many forms of functional disabilities, being this considered one of the most serious problems concerning work health (Walsh et al., 2004). These disorders are also responsible for large part of work exits, and costs with work insurance payments, as well in Brazil as in many developed countries, being accountable for labor market withdrawals, insurance payments, treatments and work rehabilitations programs.

The MSDs achieve many occupational categories worldwide. The risk population is in its majority composed by young workers. In Brazil, the occupational classes most affected by MSDs are the bankers and steel mill workers. These diseases represent around 70% of work diseases recognized by the Brazilian social security system (Costa, 2000).

3.3.2 Injuries

The injuries are another disease group with huge impact in retirement disability rates. Even after the implementation of many security measures in the work environment, the work accidents and injuries still occur. According to Oliveira & Murofuse (2001) in hospital environment, for example, from all work accidents around 31.52% occur as result of physical injuries and accidents as: wounds, intoxications, infect contagious diseases, burns and contaminations. Although, 17.3% concerning typical risks of hospital environment as perforation cutting tools, and 13.09% described as the most common risks: as physical threats, the ergonomics and the chemical damages. Other research shows the existence of age differentials concerning work accidents, being the old age group the highest risk group. This group is more work accident- and injury-prone, usually with difficult recovering (Sterns *et al*, 1985 apud Hansson *et al*, 1997).

Agnew & Suruda (1993) has studied in the US the occupational determinants responsible for the total amount of injuries, the temporary disability rates and the permanent disability rates. The results came out with 11.4% as total incidence rates, where 10.7% as temporary disability and 39.6% as permanent disability; with 79.6% as lethal injuries due to work environment. Other research studies the relationship between fall of workers in work environments and the age. It shows that the risk of work accident increases with the age of the employee. After the age 45 the incidence of serious fall increases progressively. Usually such risks attain dangerous labor environment. Kisner and Fosbroke (1994), using data from construction industry, conclude that the work injuries gradually reduce with age. However, the fatality rates – caused by work injuries –

increase with employees age. Besides together with the stereotypes of old workers, the rationality of work environment generally hinder to hire old employees in occupations which demands physical strength (Kisner & Fosbroke, 1994 apud Hansson *et al*, 1997).

3.3.3 Mental disorders: depression

According to the Fig 1 and 2, the ICD Chapter V – concerning mental e behavioral disorders – is the third group of diseases with more retirement due to disability. However, since we are considered the mental disorders in more disaggregated levels, it is possible to distinguish the differentiated incidence levels of these illnesses. Once it is established this incidence differential, the next step is (based on simulations) to see the impact on the total disability retirement hazards, after it is applied a reduction of certain causes of mental disorders.

Following the rapport of the OMS (2002), the disability rates due to mental disorders are extremely high in all parts of the world, being somewhat lesser in the developing countries; due to the overweight of other diseases in these regions, like: transmissible diseases, maternal diseases, prenatal and nutritional disorders. However, among the group of mental and behavioral disorders, many researchers consider depression the disease with the highest incidence, affecting generally the age group 20 to 40 years (Lima, 1999; Vorcaro et al, 2001; OMS, 2002; Ustun et al, 2004; Medeiros, 2006; Ribeiro, 2006). Considering the importance of depression in the group of mental disorders, we propose an exercise of reduction in the retirement disability rates, considering the risk group among the age 20 to 40 years.

3.3.4 Results of simulations

According to literature studies, we have considered a highest risk age group for each disability cause and gender. The risks groups are respectively: above age 45 for injuries, between age 20 to 40 for musculoskeletal illnesses and mental disorders. The simulations bring to light some relevant results concerning the reductions. Since we do not capture expressive changes in the scenario of 25% reduction, we present here only the observed results and the reduction scenario of 50% incidence. In order to make ease the visualization, we circle the most expressive changes.

As we can see in the FIG. 5 and 6, among the male curve there are slight changes between the age 38 to 40, and more expressive changes only after the age 55. Although, the female hazards present the same male pattern around the young age groups. There are, however, a few slight changes between the age 55 to 60, and more expressive hazards changes once past the age 65.

Figure 5 – Total male crude disability retirement hazards according to age, after reducing 50% incidence of three causes. Brazil, 01/01/1999 to 31/12/2002

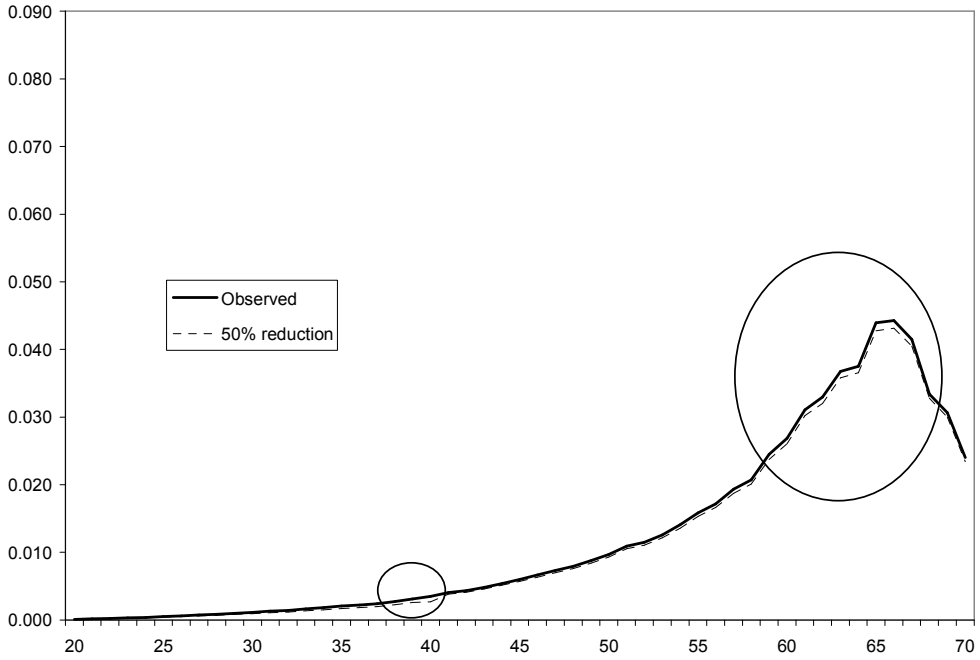
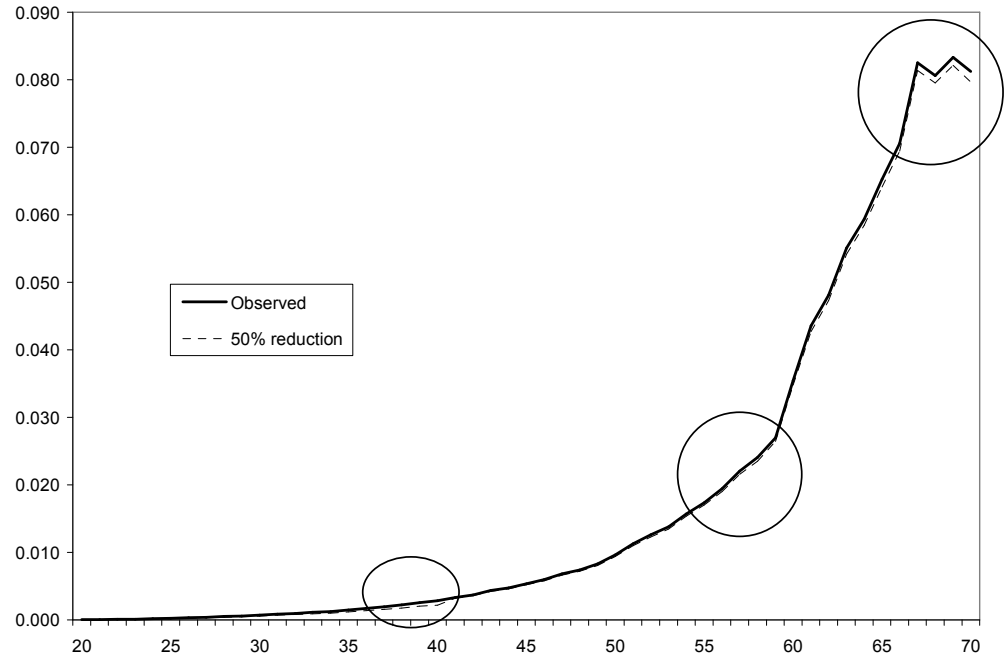


Figure 6 – Total female crude disability retirement hazards according to age, after reducing 50% incidence of three causes Brazil, 01/01/1999 to 31/12/2002



4. Discussions and conclusions

In this paper, we try to describe the transition from occupational status to disability retirement for all workers from the Regime Geral de Previdência Social. In order to

fulfill this objective, we build up multi-decrement disability retirement life tables by sex and age for the period of 1999-2002 using the DATAPREV/MPS and administrative information from the CNIS as sources for our analysis.

During the period of analysis we verified that for both sexes the risk of disability retirement is largest due to circulatory diseases and musculoskeletal diseases. As the employee age increases injuries, mental disorders and nervous system illnesses tend to decrease. However, other illnesses like circulatory and musculoskeletal diseases become more common, especially among women. Differences in the pattern of disability retirement between the sexes can be partially explained by the age structure of retirement.

The exercise, after reducing the effect of musculoskeletal diseases, injuries and mental illnesses, brings to light the necessity to reduce social security costs through the increase in the number of Brazilian taxpayers. Zelter (2008) enhances the responsibility from policies makers to take some measures, in order to prevent work injuries and MSDs.

- The creation of a comfortable work environment. The work place must accommodate the worker, in such a way that the worker can move efficiently and safely across it;

- The most frequently used devices must be locate within the worker's reach;

- In environments of serial production, the machines must be positioned in such a way that the worker does not need to bend his/her torso often, in order to get work tools. Tables must to be close to the height of the worker, with space to move the legs;

- Chairs must have adjusted height so as to support the feet, anatomical format for the hip, and backed chairs adjustable to the worker;

Besides such preventive measures, Zelter (2008) enhances some planning measures, related to the work environment:

- The workers must learn how to identify body signals; being able to identify the beginning of discomfort is important in order not to let any small pain evolve;

- Working pauses must relieve the most active muscles, they are different than the pauses to recover energy, after weighed physical effort;

- During a pause, the worker should stand up, and walk for a while. Whenever possible, the worker should stretch his muscles through working exercises;

In the field of injuries, it is important to develop work rehabilitation policies which can easily distinguish old and young laborers. Also it must to consider that the damages, caused by injuries, are generally linked with other chronicle conditions and higher risks to secondary morbidities (as pain and infections). Generally the old workers tend to answer slowly to treatments; they are also susceptible to effects of forced immobility

(Kemp, 1985 apud Hansson *et al*, 1997). For this reason, old employees need more time to recover from work injuries; they also have a higher risk of no recovering at all (Hayflick, 1994; Rowe, 1985 apud Hansson *et al*, 1997). It is also important to develop measures to slow the functional aging of workers, allowing access to rehabilitation services, identify specific requisites in order to promote better health conditions for those who lost their work capacity, and to encourage the injured laborers to continue the rehabilitation (Bellusci & Fischer, 1999; Tuomi *et al*, 1997). These are simple ways which policy makers can use to endorse expressive reductions in disability retirement rates by injuries.

The creation of programs should enhance the importance of social relations, and the formation and qualification of health teams to attend adequately laborers with mental and behavioral disorders, during their work activity. These measures can not only reduce the social security cost through disability retirement, but also the individual and social cost associate with these illnesses (Tuomi et al, 1997).

Thus, it is expected that these tables can be used to forecast or simulate the numbers of social security beneficiaries by disability cause. At the same time, it is expected that the estimated hazards by sex, age and disability cause can be used to evaluate the structural impact of causes in the general pattern of disability retirement rates, serving this knowledge of disability retirement hazards as an opportunity to develop policies of work prevention and health, and to promote a better work environment.

5. References

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