A new Italian surveillance system for occupational injuries: characteristics and initial results

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Introduction

Research and surveillance of occupational injuries is based on the ability to measure the occurrence of events and the exposure to the risks.

In Italy, good quality data on the numerator are provided by the National Insurance Institute for Occupational Injuries (INAIL) (Jacinto, 2004). However, the denominator is not available on an individual level and must be currently estimated based on the amount of salaries insured by INAIL. Such data are adequate for measuring risk variations by economic activities (Fabiano, 2001), but do not permit an injury risk assessment based on personal (e.g., sex, age, nationality, profession) or employment (e.g., type of contract, age of company) characteristics that are useful for developing and evaluating interventions with regard to current changes in the labour market (i.e., ageing of the working population, increase in foreign workers, increase in working women, precarious employment). Alternatively, the denominator of exposed population may be derived by the Labour Force (LF) Survey performer by the Italian National Institute of Statistics (ISTAT); in this case, some important risk factors of occupational injury (such as economic activities and the size of the company) are self-reported by the worker and aren't comparable to administrative statistics. Moreover, the numerator of notified injuries is derived from the population of formal employment, while in the LF Survey, informal workers are also surveyed, which represent 15% of the labour force in Italy (ISTAT, 2008). This leads to an underestimation in the risk of occupational injury in sectors where informal activities are more common. Injury rates per age and sex were also calculated estimating the denominator from the Italian National Social Security Institute (INPS) (Mastrangelo, 2008), introducing a new numerator-denominator bias, due to the differences in the coverage of the workforce insured by INAIL (numerator) and INPS (denominator). To avoid these limitations in the denominator, proportional indicators were used to describe the risk of injury stratified per sex, age and occupations within a surveillance programme on occupational differences in health aiming to identify strenuous jobs (Bena, 2005a; Bena, 2005b). However, given the huge variation in the occurrence of work accidents by occupation and economic activity, proportional indicators are not a valid alternative for surveillance.

Linking databases from different data sources on exposure and outcomes is a recommended solution for the above-mentioned limitations (Sorock, 1997). Occupational Health and Safety Italian legislation (Legislative Decree 106/2009) mandated the establishment of a nationwide database based on the most efficient use of the data recorded in current databases held by different public authorities. A surveillance system of occupational cancers based on the linkage of INPS databases, cancer registry and hospital discharge records has been implemented with success (Crosignani, 2006). As a result, the Italian Center for Disease Control (CCM) has decided to create a new

occupational surveillance system based on the linkage of work histories (INPS) and occupational injuries (INAIL).

The aim of this study is to illustrate the design, potential uses and limitations of this system. To do this, the risk estimates derived by the new linkage-based system will be compared to the ones available from previous data sources. Several preliminary examples of age and job variations in occupational injury risks will illustrate the potential of the new system.

Materials and Methods

Employment History: the WHIP Archive

INPS collects information regarding large segments of the work force in Italy for which it manages various social security provisions. The reference population (approximately 15 million people) includes all individuals employed in private companies, workers with quasi-dependent employment and self-employed persons, with the exclusion of professionals such as lawyers or architects (in other words, artisans and traders are included). This group effectively represents all production sectors in manufacturing, construction and services while public employment, predominant in education and health sectors, is not covered. In addition, other sectors, such as agriculture, are not entirely represented in INPS.

The Work History Italian Panel (WHIP) was created based on a 1:90 systematic sample drawn from the INPS database according to date of birth[1]. The employment history was reconstructed for each person sampled, including all employment periods recorded by INPS, retirement, plus any period in which the individual received social security benefits such as unemployment subsidies. The period currently covered is from 1985 to 2004.

The data regarding employees include basic demographic information (age, sex, place of birth) and several job characteristics (such as earnings, days worked, skill level, type of labour contract, temporary leaves, dates of job start and end). In addition, through a linkage with INPS' Firm Observatory, basic data about the employer are included (i.e., date of beginning activity of the firm, sector of activity, total number of employees). The data regarding self employed persons include only basic demographic information, economic activity and dates of start and termination of the work activity. The data regarding quasi-dependent workers include only demographic information and earnings.

Occupational Injuries: INAIL Database

INAIL collects information on occupational injuries that last more than three days among insured workers (approximately 18 million people). Freelancers, fishermen and some other categories of self-employed workers are not included. Also the database contains information on the injured worker (personal and occupational details), on the event of injury and its consequences (date and place of event, seriousness, health consequences), and on the way the event occurred (classified in accordance with the European Statistics on Accidents at Work (ESAW).

The injuries that occurred between 1994 and 2003 were extracted from the national INAIL database with the same sampling frame used for the WHIP archive.

Linkage

[1] Further information on the database may be found at http://www.laboratoriorevelli.it/whip.

The reference populations of the two databases differ. Not all workers insured by INPS are insured by INAIL and vice versa. The first challenge in creating an integrated database is to identify the crossover population, i.e. the population insured by both institutions. This is straightforward with the WHIP archive, because only self-employed workers as traders without employees are exempt from INAIL insurance. Since it is not possible to distinguish in WHIP the traders with- or without employees, the reference population for which the integrated database can be used for the purpose of calculating injury risks consists of employees, artisans and quasi-dependent workers.

In a first phase of the linkage, the WHIP sample was deterministically matched with the INAIL injury database using an encrypted version of the Italian tax code, which is issued by the Italian tax office to unambiguously identify all individuals residing in Italy. The encryption was done independently by the two social security institutions in accordance with a common procedure. Some unlinked injuries were recovered by lowering the equality constraint of the encrypted tax code in the last digit. In this way, all occupational injuries referring to an individual were linked to all individuals in the WHIP sample.

In a second linkage phase, every injury was matched with a work activity, where the linkage criterion was time consistency, which meant that the injury must have occurred during the work activity. It may be the case that for an individual matched during the first phase no time-consistent work activities will be found, since the injury may occur when the individual was employed in activities that do not require any INPS insurance. For example, an individual worked for a period of time as a private employee (and thus with INPS registration) but then started to work for a public administration (which requires registering with another institute) and was injured during the latter employment. The diagram of the relational database generated by the merger of INPS and INAIL databases is reported in Figure 1.

Linkage Quality Analysis

The quality of the linkage was evaluated using two different strategies.

1. Linkage Success. The success of the linkage was evaluated for two economic activities (construction and engineering) where a high linkage rate is expected due to insurance criteria in use at the two institutions. The analyses were stratified by year of occurrence.

2. Comparison with Eurostat. The rate and 95% confidence intervals of injury incidence per 100 workers was calculated (and stratified according to the variables available from Eurostat (2011): sex, age and economic activity. Only the economic activities that could be compared between the two archives were considered (the Nace rev. 1 sectors D-K: Financial and insurance activities, Manufacturing, Construction, Trade, Hotels and restaurants, Energy production and Transport). Quasi-dependent and temporary agency workers were not included due to lack of

information on economic activity. The analyses were limited to 2001, the most stable year from a data quality point of view in Eurostat.

Statistical Analysis

With reference to employed workers in 2001, the rates of injury incidences per 100 workers and the relative risks were calculated (with the relative confidence intervals at 95%), stratified per job tenure (< 3 months; 3-6 months; 7-11 months; 12-23 months; 24-35 months, >=3 years), region of birth (Mediterranean Africa; Non-Mediterranean Africa; Asia, Latin America, Europe 25; other European countries; Italy), size of company (0-9; 10-19; 20-49; 50-99; >99). Following Oleinick (1995) and Kines (2003), we calculated also a rate of serious injury[2] stratified per size of company, deal with the possible failure to report non-serious events of injury in small companies. Job tenure was calculated for every person starting from the worked weeks declared to INPS.

With regard to men working as blue collar workers or apprentices from 2000-2003, the crude relative risks were calculated and controlled for age and job tenure, using a Poisson regression model. The analyses were limited to dependent workers who were employed in economic activity classified as D-K by the statistical classification of economic activities in the European Community (NACE).

Analysis was performed using statistical software SAS 9.1 and STATA.

[2] All events that led to death, permanent incapacity or temporary disability with more than 30 days of prognosis were considered as serious injuries.

Results

The linkage success is greater than 95% in engineering and greater than 90% in the construction sector for all years considered (Table I). The percentage of injuries that do not link to the WHIP Panel decreases throughout the period of time and is steadily lower from 2000 onwards.

Employed workers included in the WHIP Panel had a rate of injury of 3.99 per 100 workers/year in 2001 (5,054 observations; CI 95% 3.88-4.10). The rate reported by Eurostat for the same year is lower (3.63 injuries per100 workers/year). The injury rates stratified per economic activity from the WHIP-INAIL sample are reported in Table II. The construction sector has the highest rates (6.48 per 100 workers/year; CI 95% 6.06-6.90), followed by the transport sector (5.05 per 100 workers/year; CI 95% 4.56-5.54). The rates calculated from the WHIP Panel are higher than those published by Eurostat in construction, trade, hotels and restaurants and financial intermediation. The rates are comparable to Eurostat in manufacturing, energy production and transport.

A comparison with Eurostat statistics is possible for other two variables: sex and age. In Table III the specific injury rates in larger sectors (manufacturing and construction) are reported. The rates are significantly higher for men and in people under 25 years of age. Compared to Eurostat, the rates are similar if ordered per rank. Main differences are in younger and older workers (manufacturing 18-24 years: 6.31 vs 7.22 injuries per 100 workers per year; construction 55-64 years: 5.90 vs 6.66 injuries per 100 workers per year).

The rates of injury and crude risk per job tenure, country of birth and size of company in 2001 are reported in Table IV. An analysis was performed only for the dependent workers employed in the economic activity NACE D-K, because their information is more complete and accurate. The higher the job tenure, the lower are injury rates. Compared with a job tenure of more than 3 years, the risk is between 25% and 38% higher between two and three years, is 70% higher if job tenure is less than one year; nearly doubles for < 3 months of tenure.

Among workers born abroad, workers from Mediterranean Africa (11.7 per 100 workers/year) and non-Mediterranean Africa (9.63 per 100 workers/year) are the groups presenting the highest injury rates. Workers from Eastern Europe also have a significantly higher rate than Italians (7.9, CI95%: 6.73-9.06 versus 4.38, CI95%: 4.25-4.52). The rates for workers born in Asia (6.23 per 100 workers/year) are of borderline significance. Larger companies have the highest rates (4.66 per100 workers/year in companies with > 99 employees). A positive relation can be observed between risk and firm size, but the differences are not statistically significant among the different size classes.

The rate of serious injury (Table V) is 0.94 per 100 workers per year (IC95%: 0.82-1.06) in

companies with less than 10 employees and 0.82 per 100 workers per year in companies with more than 99 employees (IC95%: 0.73-0.91).

The risks of injury per age and job tenure are reported in Table VI, calculated using the most recent years available, with regard to dependent men employed as blue collar workers or apprentices in the economic activity NACE D-K. The injury risk decreases with age. Young people between 18 and 24 years old have a 34% higher probability of suffering an injury compared to workers > 55 years old. Controlling by job tenure, this risk differential decreases to 19%. Increasing job tenure is associated with decreasing injury risk. Workers with a short job tenure have a 40% higher probability of suffering an injury compared to workers with more than three years of tenure (Table V). The risk differentials for these categories also remain high after controlling for age.

Discussion

The success of linkage between work histories (originated from INPS) and occupational injuries (originated from INAIL) is very high both in engineering than in construction sector sectors and for all the years considered (Table I). The existence of injuries that do not link is almost certainly due to errors in encrypted tax code but also by the number of people employed as, for example, public clerical staff, where INPS insurance is not required, even if there remains the obligation to communicate the injury to INAIL. This applies to some employees of municipalities or provinces who, by carrying out construction tasks, are considered to be in the construction sector by INAIL but are insured by different social security institutions and not by INPS. To confirm this hypothesis, INPS is currently conducting more in-depth checks on the employment history of these workers.

The comparison of the rates calculated using the WHIP-INAIL sample for the variables that match those used in Eurostat is very positive. The results are consistent for rank order. The rates calculated by the sample are higher in all the economic sectors which are known to be characterized by a higher prevalence of informal work (construction, trade, hotels and restaurants; financial intermediation is an exception). In fact, in the WHIP-INAIL sample both the numerator and the denominator are based on administrative records: this means, from the one side, that the sample do not cover informal work; from the other side, that the injury rates computed for the sampled workers are correct. Eurostat, on the other hand, acquires information on the numerator from the same administrative source (INAIL), while the denominator comes from the LF survey (ISTAT), which is based on self-declared sample data. As a result, all workers regarded as such are considered in the denominator, regardless of their administrative situation, both formal and informal workers. This means that Eurostat is prone to distortion from mis-aligned numerator and denominator data: the denominator has a wider coverage compared to the numerator, leading to an underestimation of the risk of injury. Specific injury rates by sex and age confirm these observations: main differences are in young and older workers where informal work is more widespread.

The injury risk indicators calculated according to the variables that are not present in the Eurostat data (Table IV) are consistent with statistics recorded in international literature. The high injury rates for short work contracts and the opposite trend with longer job tenure confirm the existence of higher injury risk for work insecurity (Virtanen, 2005; Quinland, 2009). The multivariate analysis (Table VI) permits evaluation of the reciprocal influence between experience acquired per work contract and age. It is, in fact, well known that short contracts and work insecurity are more common among young people (Virtanen, 2005; Berton, 2009). The preliminary

analyses presented in Table VI demonstrate that the risks mostly remain unvaried also after controlling by age. Experience is one of the most important explanations for the higher risk of injury in precarious workers (Benavides, 2006; Breslin, 2006; Fabiano, 2008). More in-depth analyses will be able to describe these relationships in detail by different economic activities and by different definitions of precarious work as the WHIP database contains specific information on work contracts. But the real WHIP-INAIL strength is in its longitudinal character which, by reconstructing the employment history of every individual person in the panel, allows us to study, for example, if the instability of the work contract is a cause or consequence of the higher risk of injury.

With regard to age, many studies show that young people are at a higher risk of injury compared to older workers (Silverstein, 2008; Salminen, 2004). The Laflamme review, however, emphasizes that the relationship between injury risk and age is complex and specific to individual work activities (Laflamme, 1995). The results presented in Table VI show that the risk of injury, despite being halved in absolute value, remains significantly higher among young people than for older workers, even after analyzing data based on job tenure. Even in this case, the WHIP-INAIL database will enable specific in-depth studies into the relationship between age and experience in different economic activities.

Several studies referring to different countries show that the risk of work injury is higher for workers born abroad in comparison with Italians (Capacci, 2005; Shenker, 2010). The rates are particularly high among those from Africa and Eastern Europe, probably related to the different duties undertaken.

The risk of injury increases as the size of company increases, although this trend does not reach statistical significance. This result appears to be in contrast to results from research conducted in other countries that describe a worsening in all occupational health and safety outcomes in small or sub-contracted companies (Quinland, 2009; Fabiano, 2004; Sorensen, 2007). With regard to injuries, the studies that have shown a lower risk in smaller companies affirm that this risk is due to a higher degree of failure to report non-serious events of injury in small companies (Oleinick, 1995; Kines, 2003). These studies reported that, by limiting the analyses to serious events of injury, small companies would actually be the companies presenting a higher risk. By calculating the rate of serious injury in the WHIP-INAIL sample (data not presented), an inversion of the trend can be observed, even if the values are not statistically significant. In this case, again, the longitudinal character of the panel will allow us to study what effect important developments in the labour market have on the risk of injury, such as subcontracting and downsizing, thus allowing for the company history to be reconstructed.

The WHIP-INAIL panel has some limitations. The panel only covers workers in the private sector and not public workers, who are covered by another insurance institution and for whom only information on injuries is available. This means that high risk categories cannot be examined in a depth in healthcare workers, who are nearly all public employees in Italy. The panel is currently being studied for extension to some categories of public workers included in the INPS archives as recipients of non-pension social security contributions including, for example, public workers with quasi-dependent contracts for which INPS manages unemployment benefits. The same is currently true for agricultural workers. The integrated database cannot be use for trade and fishing sectors due to lack of INAIL coverage in such economic activities. The Italian Ministry of Health intends to involve other national insurance institutes that cover these areas.

INPS only provides a description of exposure per economic activity, occupation in the profession and type of contract. More specific analyses with regard to jobs and/or the work activity actually undertaken are not possible. This, however, is less of a problem if evaluated in a more general context where the jobs are of less importance when the activity undertaken by workers constantly varies over time depending on production needs and an increasing flexibility of work assignments.

A further limitation is the sample size: approximately 1% of the Italian working population is registered with INPS. This sample size does not permit micro-territorial analysis. The reasonable ability to monitor work injury risks demonstrated by this sample has, however, induced the Italian Ministry of Health to implement a feasibility analysis for increasing the sample size. It was observed that a fraction of the sample - 7% of the population - that corresponds to an extraction of people born on 24 dates during a year will enable the regional analysis at the basic administrative/managerial level in Italy. The Ministry of Health also intends to monitor the consequences of work policies on health in their entirety, including safety. For these purposes, adequate linkage procedures are also being implemented for occupational illnesses, hospital discharges and causes of death. It will also be possible to monitor the less serious consequences on health given that a recent change in legislation currently being implemented in Italy will require companies to notify INAIL of any injuries with a temporary disability of less than four days.

Another limitation is timeliness, since data are currently available only through 2003. It is clear that, in line with the timelines required for administrative paperwork to guarantee the quality of information, more timely data would enable us to study the effects of labour market changes on health more quickly. The Italian Ministry of Health is also working on this point, passing from an experimental phase to a more functional phase and inserting the database into a national database of

prevention in the workplace required by recent occupational health and safety legislation (Legislative Decree 106/2009).

In conclusion, the longitudinal WHIP-INAIL database, created from a deterministic linkage between existing sources of data, has demonstrated an ability to correctly estimate the risk of injury. Its accuracy is confirmed by a comparison with Eurostat statistics and the consistency of preliminary results with results provided in published literature. As a result, in Italy, it is finally possible to describe injuries based on some main characteristics of the recent changes in the labour market, such as precariousness of work, ageing of workers, and migration. The sample is longitudinal and can, therefore, contribute to describing the development of the phenomena over time, a capacity which importance has been highlighted by many authors (Virtanen, 2005; Shenker, 2010; Souza, 2010).

Furthermore, the Ministry of Health is completing procedures to extend the sample and to increase the health outcomes for which a follow-up is available. Although some limitations will still be there – workers in the public sector, for example, which are about 35% of Italian workers, will not be covered – the insertion within a national database of prevention in the workplace will render it a stable and updated system for monitoring the health of workers in Italy which is able to describe the main characteristics linked to changes in the labour market.

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