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Economic Impact of Ice and Snow Related Injuries in Russian Regions

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ABSTRACT

In recent years, there has been a dynamic increase in injuries associated with winter slippery conditions on the streets of settlements. Injures directly affect the quality of life and costs of specific people, and indirectly – the economic performance of various organizations and foundations to which the injured is related. The costs and loss of profit of organizations, municipalities and the state, due to the winter injuries of the population are analyzed. To this end, an analysis of foreign and Russian studies and various aspects of injuries associated with a controlled cause, icing has been carried out. Developed tools and methods of calculation. The results of the paper indicate that injuries derived from winter slipperiness can has a substantial negative effect on a region's economy by decreasing it GDP by more than 0.1%. In conclusion the authors stress the importance of enhancing the current statistical monitoring system in Russia to help prevent winter related injuries and implement efficient methods of preventing road icing to minimize the negative economic impact.

KEYWORDS:

ice, injury, disability-adjusted life year, DALY, economic impact.

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1. INTRODUCTION

Severe climatic conditions often have negative consequences that are not always obvious at first glance. In this case we are talking about ice and injuries. The research of this issue is conducted primarily in Denmark, Sweden, Norway, Finland, Canada, and the United States. The object of study is not only statistics, but also the field of activities of victims, the places of injuries and other characteristics (Ali, Willett, 2015). The problem of ice and injuries exists in Russia, and the corresponding statistics only increases every year. Among the reasons for the temporary disability of the Russian population injuries due to icy constitute about 15% becoming the cause of 15–20% of disability cases (Aksenova, 2014). Various injuries rank second among the causes of disability of the population and the first among the causes of death (Yurkov, 2007).

In the recent years, due to the worsening weather conditions (icy rains, sharp temperature drops, an increase in the number of "zero crossing") injuries turn out to be relatively more severe, more often there is a lethal outcome. Along with accidents due to poor road conditions, the level of pedestrian injuries is one of the key indicators reflecting the quality of winter road maintenance (Abeysekera, Gao, 2001; Konovalov, 2007; Grechukhin, 2012; Tsaregorodtsev, Shvetsov, 2011).

The goal of this article is to analyze the consequences of injuries due to ice and give their economic evaluation. The potential economic costs of various subjects of economic activity arising as a result of injuries of the population are considered. The influence of the level of ice traumatism on financial costs of various organizations and on victims themselves was evaluated on the basis of different conditions and parameters.

2. INJURIES DUE TO ICY CONDITIONS AND DISABILITY OF CITIZENS

All over the world city dwellers often turn to trauma centers due to ice injuries ("Ice" traumatism, 2017; Abeysekera, Gao, 2001; Ruotsalainen, Ruuhela, Kangas, 2004). In Sweden every winter more than 100000 pedestrians do so (Abeysekera and Gao, 2001). In Finland 50000–70000 incidents of pedestrians' and cyclists' falling are recorded annually due to the fact that roads are covered with ice and snow (Williams, 2016). For the same reason in Canada, in Toronto alone, almost 30000 people were hospitalized from 2006 to 2015 (Ice traumatism, 2017). In the US about 5% of all claims of disability are caused by injuries on icy roads. Such falls occur six times more often than falls from ladders, buildings, etc. (Dawson, 2013). Disability caused by injuries requires the costs of medical care. According to the study conducted by the Maine Department of Employment (USA), accidents due to icy conditions result in an average loss of more than 25000 days of work time (Dawson, 2013).

According to the World Health Organization (WHO), in Europe injuries (including falls) are the leading cause of death for people aged from 5 to 49 – 6,1% of all deaths. WHO identifies three main causes of deaths from injuries: self-inflicted violence (123000 cases), road traffic injuries (92000 cases) and falls (78000 cases), which together account for more than half of all deaths. Falls refer to unintentional injuries. 10% of all deaths and 16% of all disabilities occur every year due to injuries (intentional and unintentional) (Traumatism in Europe, 2014). According to WHO estimates, for each case of death there are 24 hospitalizations and 145 requests for outpatient care (Traumatism in Europe, 2014).

Injuries also lead to an increase in such an indicator as disability-adjusted life year (Disability-adjusted life year, DALY) as a result of premature death, illness, injury or disability. One DALY is equal to one year of life lost for the above-mentioned reasons. In 2011 32 million DALY were lost in Europe as a result of injuries primarily due to falls (23%), injuries sustained in road accidents (21%) and self-inflicted violence (17%) (Fig. 1) (Traumatism in Europe, 2014).

On the part of the research community the greatest interest is generated by economic costs of road traffic accidents. At the same time, the problem of financial consequences of ice injuries on pedestrian road sections is not so widely studied by both Russian and foreign researchers. In the European Union the loss of the state's gross domestic product from road traffic accidents can be up to 4% (Trauma in Europe, 2014). The probability of being injured or killed by injury is 3–4 times greater for

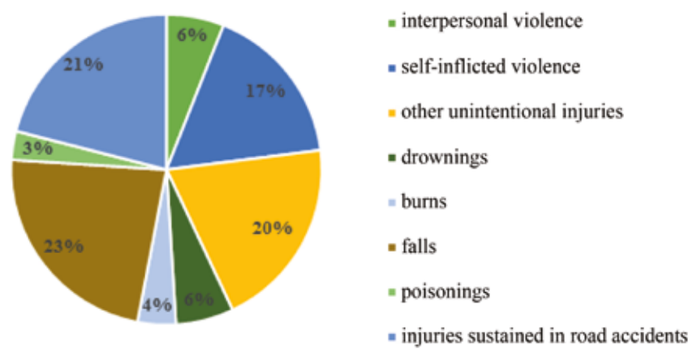

Fig. 1. The share of various causes of loss of healthy years of life in Europe in 2011 (Traumatism in Europe, 2014)

people with low incomes and living in low- and middle-income countries. There is also an increase in injuries among people under the influence of alcohol (Prevention of injuries in Europe, 2010; Injuries and violence, 2006; Konovalov, 2008).

According to the research of domestic scientists, in the structure of the reasons for seeking medical help street injuries account for about 32% in St. Petersburg and about 40% in Astrakhan. From 2006 to 2010 street injuries in Astrakhan increased by more than 1,7 times (Grechukhin, 2012). Moreover, 70% of street injuries were caused by changes in weather conditions (Konovalov, 2008; Grechukhin, Odinochenko, Zimniy, etc., 2011).

To prevent injuries caused by icy conditions it is necessary to clearly understand the specifics of causal factors. The weather factor is known for different seasonality: the majority of injuries occurred in winter due to temperature changes. The social factor is expressed in the fact that pensioners (O'Neill, 2016) and the employed population (Ali, Willett, 2015) are most susceptible to injuries.

Fractures and dislocations (more than 40% of all cases), soft tissue bruises and sprains (more than 50% of cases), minor injuries (about 2%) lead in the types of injuries. As for localization, damage to lower extremities (more than 40%) happens most often followed by damage to upper extremities, pelvis and tailbone (about 30 and 20%, respectively) (Yurkov, 2007; Grechukhin, Odinochenko, Zimny et al., 2011; Konovalov, 2008). For complex fractures the recovery period can reach 10–12 weeks, which means that for a long time the victim will be absent from work (Traumatology, 2008).

3. DETERMINATION OF POTENTIAL ECONOMIC COSTS

A significant share of the working population among the victims and the severity of injuries require additional research in order to identify possible material consequences for various economic actors.

The statistics of the US Centers for Disease Prevention and Control shows that each year the costs associated with falls on slippery icy surfaces exceed 34 billion dollars with two thirds of this amount spent on medical treatment. As a rule, most of the costs of medical treatment are covered by the employer's insurance premiums or the victim's personal insurance premiums, however, the final claim to insurance companies/ funds may significantly exceed the paid amount. Payments do not cover the costs of drug treatment, physiotherapy and the maintenance of medical equipment. When calculating the total economic costs of injuries it becomes clear that injuries caused by ice are fraught with great costs not only for the victim, but also for employers (Estimating the economic costs, 2012).

Table 1
Potential costs of economic entities caused by injuries among pedestrians due to icing

Subject	Types of costs
Costs of employers (direct)	Temporary disability benefits paid to employees for the first three days of a sick leave. Additional expenses of the employer to compensate the employee for the costs that are required for: • provision of qualified paid medical care; • purchase of medicines; • purchase of special means necessary to care for the injured person; • payment for services, the necessary equipment or transportation
Costs of employers (indirect)	The costs associated with a decrease in labor productivity as a result of the absence of an injured employee from work cause: • deterioration in the quality of products (services rendered); • increase in the timeline of production (services rendered); • reduction in the volume of products (services rendered). The costs of compensation for overtime of employees performing the responsibilities of the injured employee, who is absent. Additional costs for the selection, recruitment and training of new personnel, if the injured employee cannot return to work for health reasons
Costs of employees (direct)	Expenditures on medicines and other medical services for recovering from injury
Costs of employees (indirect)	Loss of part of the salary that the injured employee did not receive as a result of being absent from work due to injury. Costs associated with looking for a new job if the employee is not able to return to his former work
Public expenditures (direct)	The costs of medical care and the payment of temporary disability benefits from the Social Insurance Fund starting from the fourth day of a sick leave. Subsidies and payments for the replacement of the victim's wage if he is unable to return to his previous work. Subsidies and benefits in the event of disability. The use of public health services to transport the victim. The loss of tax proceeds
Public expenditures (indirect)	Indirect decrease in gross regional product as a result of reduction in company's productivity due to the absence of an employee from work

According to the Russian legislation, if a working person was injured due to icing, legal relations arise that involve:

- the injured person — a pedestrian (employee of the organization) who was injured on the ice and temporarily lost his ability to work;
- the organization in which the victim is employed and which makes regular contributions to the Social Insurance Fund of the Russian Federation;
- the state represented by the Social Insurance Fund of the Russian Federation.

Table 1 shows the main potential economic costs, direct and indirect, for these entities. In accordance with the law, victims have an opportunity to recover damages related to medical treatment if the guilt of the organization responsible for the territory where the victim fell is proven (Civil Code, 1996).

4. METHODOLOGY FOR ASSESSING POTENTIAL ECONOMIC CONSEQUENCES

In order to assess potential economic effects associated with injuries due to winter slippery conditions, the authors developed a model toolkit. The formed toolkit makes it possible to assess the impact (expressed in monetary form) of injuries due to ice or snow on pedestrian sections of roads. In assessing the economic consequences of injuries we used:

- *demographic indicators:*
  - population of the city;
  - number of victims;
  - number of hospitalized population;
  - number of employed population;
  - structure of employed population by age groups;
  - structure of employed population by education level;
- *economic indicators:*
  - gross regional product of the city;
  - the minimum subsistence level;
  - the average nominal gross monthly wage;
  - profitability of sold goods, products (works, services);
  - the rate of personal income tax
  - premium rates for pension, social and medical insurance;
  - income tax rate;
  - data on the costs of municipal and regional budgets;
  - data on the revenues of city budgets, including the income from receiving personal income tax;
  - data on expenditures of the budgets of Social Security Fund, Compulsory Medical Insurance Fund, Pension Fund of the Russian Federation;
- *additional indicators:*
  - standards of financial costs per unit of the volume of provided medical services;
  - he list of medications used for injuries and their price (Federal Service).

Calculations of potential effects were carried out with division into macro and micro levels. The macro level includes the impact on the gross regional product and the effects for the municipal and regional budgets of the region, the micro level include the effects for the employer and for the victim.

For municipal and regional budgets the Social Insurance Fund and the Mandatory Medical Insurance Fund the effects are calculated as a sum of medical expenses and lost tax revenues (Table 2).

4.1. MACRO LEVEL

The costs of medical care of the injured person (emergency medical assistance, hospitalization in a medical institution and the provision of medical treatment on an outpatient basis

Table 2
Formation of effects for economic entities at macro level

Economic entity	Effect for economic entity
Mandatory Medical Insurance Fund	Increased medical expenses for victims: • payment for emergency medical assistance; • payment for hospitalization in medical organizations (26% of the cost for 1 hospitalization); • payment for medical services on an outpatient basis (47% of the cost of 1 visit). Reduction in insurance contributions to the Mandatory Medical Insurance Fund
Social Security Fund	Compensation for sick leaves of injured persons. Reduction in insurance contributions to the Social Security Fund
Pension Fund of the Russian Federation	Reduction in insurance contributions to the Pension Fund of the Russian Federation
Regional budget	Increased medical expenses for the treatment of injured persons: • payment for emergency medical assistance; • payment for hospitalization in medical organizations (74% of the cost of 1 hospitalization); • payment for medical treatment on an outpatient basis (53% of the cost of 1 visit). Reduction in contributions from income tax
Municipal budget	reduction in contributions from personal income

(Resolution, 2015)) are calculated according to the following formula:

$$C = \sum N_i \, НФЗ_i, \quad (1)$$

where N_i – is a number of injured persons (in the case of hospitalization – hospitalized persons) in the i-th region, people; $НФЗ_i$ – standards of financial costs per unit of the corresponding volume of medical assistance, rubles/treatment.

The distribution of costs of medical treatment for injured persons among the Mandatory Medical Insurance Fund and regional budget occurs by multiplying the cost per victim on the appropriate share of costs attributed to the costs of the Mandatory Medical Insurance Fund or the regional budget (see Table 2).

The reduction in contributions to the Mandatory Medical Insurance Fund, the Social Security Fund and the Pension Fund of the Russian Federation is calculated according to the general formula:

$$\Delta_{фонд} = \frac{S}{n_{дн}} T_{фонд} t N, \quad (2)$$

where S is an average monthly nominal gross salary, rubles/person/month; $n_{мес}$ is a number of days in a month; $n_{дн}$ – количество дней в месяце; $T_{фонд}$ – the rate of insurance contributions to the relevant fund (the Mandatory Medical Insurance Fund, the Social Security Fund and the Pension Fund of the Russian Federation), %; t – the duration of disability of the injured person, days; N – the number of victims, people.

The costs of the Social Security Fund for the compensation of sick leaves are calculated by formula:

$$C_{ФСС} = \left(Nl_1 \frac{M}{n_{дн}} 0,6 + Nl_2 \frac{S(1 - T_{НДФЛ})}{n_{дн}} 0,8 + Nl_3 \frac{S(1 - T_{НДФЛ})}{n_{дн}} \right) (t - t_{раб}), \quad (3)$$

where l_1, l_2, l_3 – дare the shares of employed people younger than 24, 25–29 years old, 30 and older in the economy, % respectively; M – the size of the minimum subsistence per capita level, rubles/month; $T_{НДФЛ}$ – the rate of the personal income tax, %; $t_{раб}$ – the number of days of temporary disability paid by the employer.

The reduction in income tax can be calculated by the following formula:

$$\Delta I = I_{сниж} - I_{тек}, \quad (4)$$

where $I_{сниж}$ – is the amount of budget revenues from income tax with a decrease in gross regional product (GRP) as a result of suspension of economic activity of the injured people in the region, million rubles; $I_{тек}$ – the volume of budget revenues from income tax with the actual volume of GRP, million rubles.

Tax revenues are distributed as follows: 17% of the volume goes to the regional budget, 3% to the federal budget (Tax Code, 2000, Chapter 25). The amount of contributions from income tax is calculated by the following formula:

$$I_{тек} = \frac{G}{365} \overline{t} R_{пр} T_{нп}, \quad (5)$$

where G is the gross regional product in basic prices, million rubles; $\overline{t}$ – an average duration of disability of the injured people in the region, days; $R_{пр}$ – profitability of the sold goods, products (works, services), %; $T_{нп}$ – the rate of income tax, %.

With a decrease in GRP as a result of suspension of economic activity of the injured persons the amount of contributions to the budget from income tax is calculated by the following formula:

$$I_{сниж} = \left(\frac{G}{365} t - G_{упущ} \right) R_{пр} T_{нп}, \quad (6)$$

where $G_{упущ}$ –is the potential lost profit in the amount of the lost part of the gross regional product (GRP).

The assessment of the amount of lost profits for the regional economy has a number of methodological features. The formation of GRP is influenced by the value of fixed assets, investments in fixed assets, the average annual number of people employed in the economy as well as human capital. The latter concept unites many factors: education, health, culture, quality and standard of living, with education being the key factor in the development of human capital (Yamilova, Nigmatullina, 2014; Prokofyeva, Rybakov, Pchelkina, 2012)

The level of education of the population employed in the regional economy has a significant impact on the GRP (Ignatiev V.M., 2015; Asp, Uhmavaara, 1999; Lapochkina, 2009; Kuzin, Kuzin, 2017; Koritsky, 2009; Hanushek, Wessman, 2007; Vaganova A.S., 2014; Nevezhin, Novichkova, Parkhotsik, 2014). With an increase of investments into education by 1 ruble the level of per capita GRP increases by almost 12 rubles (Ignatiev, 2015). Therefore, it is proposed to calculate the potential negative effect on GRP on the basis of the victim's contribution to the gross regional product (GRP) adjusted for the level of education:

$$G_{упущ} = \left(\frac{Gk_1 / N_{ВО} N_w}{365} t \right) + \left(\frac{Gk_2 / N_{СПО} N_x}{365} t \right) + \left(\frac{Gk_3 / N_{СО} N_y}{365} t \right) + \left(\frac{Gk_4 / N_{НО} N_z}{365} t \right), \quad (7)$$

where k_1, k_2, k_3, k_4 – is a coefficient of the influence of educational level (higher, secondary vocational, secondary general, basic general (absence thereof), respectively) on GRP (shows the share of the factor "educational level" on GRP); $N_{ВО}$, $N_{СПО}$, $N_{СО}$, $N_{НО}$ – the number of people employed in the economy with higher education, secondary vocational education, secondary education, general education/lack thereof, people, respectively; w, x, y, z – the structure of employed people according to the level of education (higher, secondary vocational, secondary general, basic general (absence thereof), respectively), %.

4.2. MICRO LEVEL

The effects for the employer are calculated as follows:

$$\Delta_{раб} = B_{раб} + H + E, \quad (8)$$

where $B_{раб}$ is the employer's lost profit from the absence of the injured person from work, rubles; H – the payment for sick leaves of injured persons, rubles; E – the employer's savings on payments for the injured persons, rubles.

The employer's lost profit can be calculated as follows:

$$B_{раб} = \left(\left(Nw \frac{s}{n_{мес}} \overline{t} k_1 \right) + \left(Nx \frac{s}{n_{мес}} \overline{t} k_2 \right) + \left(Ny \frac{s}{n_{мес}} \overline{t} k_3 \right) + \left(Nz \frac{s}{n_{мес}} \overline{t} k_4 \right) \right) / T_{ФОТ}, \quad (9)$$

where $T_{ФОТ}$ is the share of wage fund in the cost of products depending on the type of economic activity,%.

The employer pays for the first three days of a sick leave (Federal Law, 2006), the amount is calculated by the following formula:

$$C_{бол} = \left(Nl_1 \frac{M}{n_{мес}} 0,6 + Nl_2 \frac{s(1 - T_{НДФЛ})}{n_{мес}} 0,8 + Nl_1 \frac{s(1 - T_{НДФЛ})}{n_{мес}} \right) t_{раб}. \quad (10)$$

The employer's savings from payments to the injured person can be calculated by the following formula:

$$E_{раб} = \frac{NS + (NSF)}{n_{мес}} t, \quad (11)$$

where F is the total rate of insurance premiums deducted to the Mandatory Medical Insurance Fund, the Social Security Fund and the Pension Fund of the Russian Federation,%.

The impact on employees is calculated:

$$\Delta In = \Delta S + \Delta W + C_{л}; \quad (12)$$

$$\Delta S = \frac{NS(1 - T_{НДФЛ})}{n_{мес}} t; \quad (13)$$

$$\Delta W = C_{фсс} + C_{б}; \quad (14)$$

$$C_{л} = N \sum (b_i P_i), \quad (15)$$

where ΔS is the lost wages; ΔW – sick leave payments; $C_{л}$ – the costs of medicines[1]; $C_{ФСС}$ – payments for sick leaves by employers for the first 3 days of illness; $C_{б}$ – payments for sick leaves by the Social Security Fund starting from the fourth day; b_i – the number of a particular type of drugs, pieces; P_i – the price of the corresponding drug, rubles.

The calculations were carried out on the basis of an average disability period of 45 days (Traumatology, 2008). The following assumption is made: when calculating the effects for an employer the wages of employees who partially perform the duties of disabled employees (if possible) remain unchanged, that is, the employer does not incur additional overtime costs for the employees who perform the duties of the disabled ones.

5. THE RESULTS OF MODEL CALCULATIONS

Based on the presented methodology the authors carried out model calculations for the cities of Perm, Omsk, Voronezh and Samara. The empirical data of the level of ice traumatism in the analyzed cities were obtained upon the request of information from the Winter Road Maintenance Association.

The conducted model calculations show that economic consequences of ice injuries can be both positive and negative. The negative effect is primarily relevant for the gross regional product of a city/region, the budget of the regional branch of the Social Insurance Fund and for injured persons. Conditionally the positive effect can be obtained by employers who save on wages.

For more accurate calculation of the effect for the employer it is possible to change the type of economic activity prevailing in the city: "service sector" and "material-intensive production" as two "borderline" activities based on the criterion of the "share of wage fund in production costs". Therefore, there is a potentially lost profit for the employer due to the different contribution of employees (the injured ones) to the final results of the organization's activities.

The conditionally positive effect is significantly reduced if the employee does not work in the service sector, but in material-intensive production and his contribution to the final results of the company's activity varies (Table 3). The data on the number of people injured as a result of traumatism were provided upon request from the Winter Road Maintenance Association.

Table 4 shows potential consequences for participants of economic activity in case of winter injuries in Perm, Omsk[2], Voronezh and Samara. It should be noted that the obtained possible effects for individual subjects cannot be summed up by direct calculation, since the expenses of some participants of economic relations are at the same time profits for others. For example, the costs of payments for sick leaves from the Social Security Fund and at the expense of employers are the

Table 3
The comparison of economic effects for employer

City	The number of injured persons, people		The effect for employer, mln. rubles	
	absolute	relative, %	service sector	material-intensive production
Perm	7684	0,75	193,29	27,13
Samara	632	0,05	13,54	0,7
Omsk	1500	0,13	35,77	4,53
Voronezh	6253	0,6	152,85	41,17

[1] A standard minimum set of drugs prescribed for injuries was used.
[2] Data for Omsk are given for 1 month of 2017 (for March), data for other cities cover the entire autumn-winter period of 2016–2017.

Table 4
Potential economic effects from winter injuries in 2016-2017, mln. rubles.

Indicator	Perm	Samara	Omsk	Voronezh
Macrolevel	– 1216,78	– 101,37	– 267,78	– 751,85
Impact on the gross regional product of the city (share)	– 661,36 (– 0,158%)	– 45,91 (– 0,010%)	– 170,06 (– 0,027%)	– 474,72 (– 0,127%)
Effect for the budget, city, subject, the Mandatory Medical Insurance Fund, the Social Security Fund and the Pension Fund of the Russian Federation	– 555,43	– 55,47	– 97,72	– 277,13
Microlevel	—	—	—	—
Effects for employer	193,29	13,54	35,77	152,85
Effects for employees	– 31,99	– 2,15	– 5,12	– 19,12
Note: "–"– potential conditionally negative effect for subject "+" – potential conditionally positive effect.				

Table 5
Potential economic effects from winter injuries in Perm in 2016–2017

Indicator	Effect, mln rubles	In relation to what the effect is calculated for.	Effect, %
Macrolevel	–1216,78	—	—
Macroeconomic effect	–661,36	Gross regional product	–0,158
Budget effect	–555,43	—	—
Medical expenses:			
payment for emergency medical assistance	–430,06		—
	–13,74	Budget of CMIF	
payment for hospitalization in medical organizations	–187,44	Regional budget (74%), budget of CMIF (26%)	–0,055
			–0,408
payment for medical services on an outpatient basis	–24,59	Regional budget (53%), budget of CMIF (47%)	
			–0,053
payment for sick leaves by the Social Security Fund	–204,29	Budget of SSF	
			–1,742
Tax revenues:	–44,91	—	—
reduction in personal income tax	–34,86	Municipal budget	–0,515
		Regional budget (17%),	–0,030
reduction in income tax	–10,05	Federal budget (3%)	
Reduction in insurance premiums Social and medical insurance funds, pension fund:			
снижение платы страховых взносов в Фонд	–80,45	Budgets of SSF, CMIF, PFRF	
reduction of insurance premiums to the Social Security Fund	–7,78	Budget of SSF	–0,066
reduction of insurance premiums to the Compulsory Medical Insurance Fund	–13,68	Budget of CMIF	–0,055
reduction of insurance premiums to the Pension Fund	–58,99	Budget of PF	–0,049
Microlevel	—		
Effects for employer:	193,29		
loss of profits due to the absence of employees from work	–146,42 –8,89		
paid sick leaves	348,60		
savings in wages	–31,99		
Effects for employees:			
damage due to lost wages	–233,29		
payments of sick leaves	213,19		
costs of medicines	–11,88	Income of injured persons	–5,3

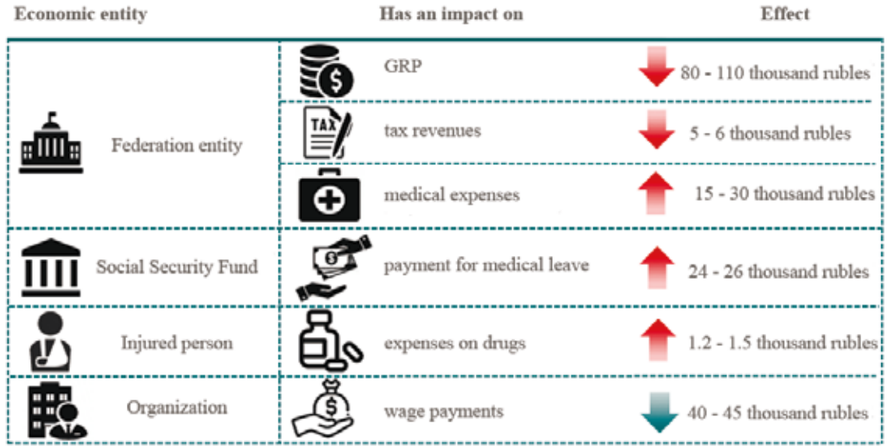

Рис. 2. Модельный расчет экономических эффектов в случае травмы в расчете на одного человека

income of injured persons on sick leave. The detalization of integrated indicators as exemplified by the services sector in Perm is presented in Table 5.

The summarized results of potential consequences for different participants of economic activities per person in a city with a population of over 1 million people and with disability duration of 45 days are presented in Fig. 2.

In a city with a population from 500 thousand to 1,5 million people on average 7000 people are injured during winter due to icy conditions. According to the results yielded by modeling, the potential negative effect may be about 0,8–1,1 billion rubles for one city at the macro level. In Russia 22 cities have a population from 500 thousand to 1 million people and 13 cities with more than 1 million people, which means that at the federal level the potential negative macroeconomic effect of slippery conditions traumatism may be more than 30 billion rubles a year.

We should also consider the economic consequences for the Social Security Fund, which bears the brunt of the costs of sick leaves. The cumulative negative effect for the SSF (in the form of payments for sick leaves for injured people and sick leaves for parents of injured children, as well as a decrease in insurance contributions due to the absence of accrued payroll payments) for the period of disability (45 days) exceeds the revenues of the SSF from the same number of injured people by more than three times (Table 6). The SSF is not able to carry out its core activities based only on contributions from the working population and employers.

6. CONCLUSIONS AND RECOMMENDATIONS

The costs of maintaining roads in the autumn-winter period (cleaning from snow and ice) are included into the budgets of the entities of the Russian Federation. However, inefficient work of cleaning pedestrian areas may lead to additional costs for the regions in terms of compensations for the consequences of injuries.

Today at the federal level there is no system of official statistics (monitoring on a regular basis) of injuries to pedestrians as a result of unsatisfactory maintenance of streets (sidewalks) and courtyards. Accordingly, one can have an objective picture of winter injuries due to icy conditions only on the basis of monitoring of media reports and individual statistical reports from various sources.

Table 6
Effects for the Social Security Fund, mln rubles.

City	Cumulative negative effect	The volume of financial receipts of the SSF estimated at an annual rate.
Perm	–212,07	62,21
Samara	–16,34	4,72
Omsk	–39,61	11,50
Voronezh	–158,29	45,50

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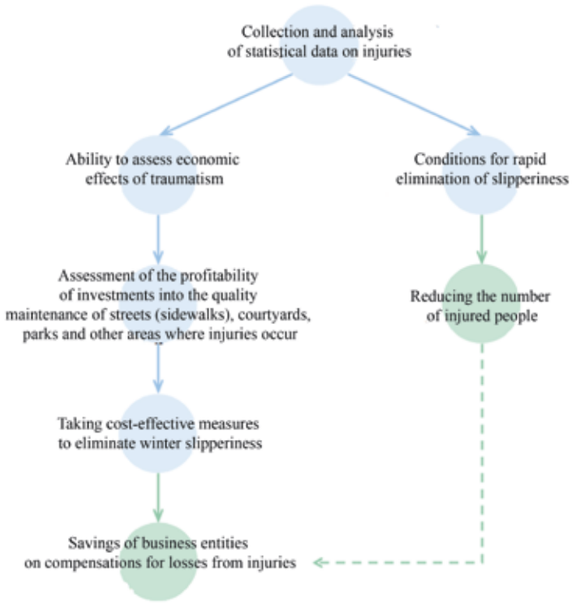

Fig. 3. Effects of the introduction of a system for collecting and analyzing statistical data on injuries associated with winter slippery conditions on a regular basis.

The creation of a system for collecting statistical information about the regions of the Russian Federation would make it possible to solve a number of problems:

- to thoroughly and adequately assess the damage to business entities associated with the loss of working ability of citizens as a result of falls;
- to create an information system for prompt elimination of slippery road conditions and to reduce the number of injured people.

As a result, it is proposed to minimize the economic damage associated with the spending of budget funds and the funds of citizens themselves on compensatory measures. The proposals for improving the existing approach to the monitoring of injuries caused by winter icing are presented in Fig. 3

The system of collection and recording of indicators reflecting the injuries of citizens due to icy weather conditions on the territories to be cleaned must include not only the documentation of injuries, but also the territorial characteristics of the sites of incidents, indicators that make it possible to carry out the assessment of economic damage and the magnitude of potential indirect and direct costs. Therefore, a further study of the problem of injuries associated with controllable causes (icing) seems to be important from the point of view of changing approaches to cleaning winter roads and eliminating the consequences of this factor in the future.

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