

# THE AWARENESS OF AIRLINE PASSENGERS ABOUT THE RISK OF DEEP VEIN THROMBOSIS DURING AN AEROPLANE FLIGHT

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## ABSTRACT

**Introduction:** Venous thrombosis associated with immobilization during travel is also called economy-class syndrome or traveller's thrombosis. The risk of deep venous thrombosis (DVT) during a long flight is about 0.02 to 2.7% and increases with the duration of the flight.

**Material and methods:** The aim of the study was to determine the level of knowledge of airline passengers regarding the relation between the flight and the occurrence of venous thrombosis. Four hundred airline passengers took part in the study. An anonymous questionnaire was conducted.

**Results:** Fifty-two per cent confirmed the potential influence of long air travel on the increased risk of thrombosis, including the following: prolonged sitting, flight duration which increases the risk, and variation of pressures and conditions in the aircraft compared to those prevailing at sea level. The question about the possibility of taking preventive actions during a long flight by plane was answered by 51% of the respondents. Sixty per cent of the respondents indicated exercises, 45% indicated drugs, and compression products were mentioned by 23%. The terms "economy-class syndrome" or "traveller's thrombosis" were unknown to most of the respondents.

**Conclusions:** Despite easy access to the Internet and magazines, knowledge among travellers remains low when it comes to the connection between deep vein thrombosis morbidity and travelling by plane, and similarly in terms of prevention and risk factors. It is essential to take up large-scale and systemic actions that could enhance the awareness of minimising the risk of DVT.

**Key words:** economy-class syndrome, traveller's thrombosis, venous thrombosis after air travel.

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## INTRODUCTION

In series of publications, venous thrombosis associated with immobilization during travel is also called economy-class syndrome. The common name in the past as the economy-class band is now rarely used, inter alia due to the fact that the occurrence of thrombosis is not only related to air travel in less convenient economy-class conditions. The term was first used in 1977 by Semington and Stack [1]. Venous thromboembolism, clinically manifested as deep vein thrombosis and pulmonary embolism, is still the third cause of death among vascular diseases. The annual incidence worldwide is about 1–2 cases per 1000 in the adult population [2]. The link between long-term air travel and the possibility of venous thrombosis was first noticed in 1954 by Homans, who described two cases of flight-related thrombosis [3]. Currently, this topic is the subject of increasing discussions, the search for risk

factors, and the implementation of prevention. However, it does not necessarily translate into an increase in knowledge among passengers. According to the results of the conducted studies, it is estimated that the risk of post-flight thrombosis (most often clinically asymptomatic) is 0.5–2.8% [4]. In 2019, based on statistical data obtained from the Internet (<https://zbiam.pl/artykuly/transport-lotniczy-na-swiecie-w-2019-r>), it was estimated that worldwide, commercial airlines carried just over 9 billion passengers. Compared to 2018, there was an increase of 3.4%. In Poland, based on data obtained from the Civil Aviation Authority ([www.ulc.gov.pl/pl/regulacja-ryнку-statystyki-i-analizy-ryнку-transportu-lotniczego/3724-statystyki-wg-portow-lotniczych](http://www.ulc.gov.pl/pl/regulacja-ryнку-statystyki-i-analizy-ryнку-transportu-lotniczego/3724-statystyki-wg-portow-lotniczych)), around 49 million people travelled by plane in 2019. Compared to 2018, there was an increase of 7.2%. The course of thrombosis in at least 50% is asymptomatic or only slightly symptomatic, which

causes frequent underestimation of the syndromes by patients (in the case of leg vein thrombosis, the percentage of asymptomatic patients seems to be even higher) [5]. The often uncharacteristic course of symptoms related to the development or already present thrombosis may be associated with pain and/or swelling of the limb. However, at this point, it should be emphasized that a number of other diseases can lead to similar problems, including chronic venous disease, which is relatively common in the adult population.

A number of factors related to airplane conditions and those directly related to the traveller are potentially responsible for the occurrence of venous thrombosis. Blood stasis, hypercoagulability, and endothelial damage are the 3 components of the Virchow Triad, which play an important role in the formation of blood clots in the vessels. The differences in conditions on board significantly affect the 3 above-mentioned factors. Oxygen hypobaria caused by lower atmospheric pressure leads to a decrease in blood saturation to 90% among healthy people. In the elderly and those with lung and heart diseases, blood saturation may drop even to 80% [6]. Hypoxia reduces the fibrinolytic activity of endothelial cells and damages platelets, which causes hypercoagulability and leads to the release of vascular relaxing factors, which slow down the flow. Air humidity in aircraft cabins is only 10–20% (comparable to desert conditions) and promotes rapid dehydration by evaporation [1, 6]. In addition, long-term immobilization reduces the flow in the lower limbs by up to 2/3, leading to blood stagnation. The risk factors for thrombosis related directly to the health of passengers include the following: female gender, age > 65 years, overweight, height > 185 cm, use of oral contraceptives, history of deep vein thrombosis, surgery during the preceding 4–6 weeks, flight, trauma, cancer, or current thrombophilia [7, 8].

The presence of individual risk factors significantly influences the overall risk of long-term immobilization during travel. The global assessment of the risk of venous thromboembolism in this population allows us to distinguish patients with a low, moderate, or high risk of thrombosis (Table 1) [1, 9–11].

Another important issue is flight duration. The risk of thrombosis among passengers on flights lasting less than 4 hours in relation to non-travellers is about 2 times higher (odds ratio [OR]: 2.20; 95% CI: 1.29–3.73) [12, 13]. Studies have shown that the increased risk of thrombosis persists not only during the flight, but also for at least 4 weeks after the flight [7]. For long flights (more than 12 hours as a single or as multiple flights), the risk of travel-related thrombosis is approximately 3 times higher (OR: 2.75; 95% CI: 1.44–5.28) [14]. Awareness of the problem of travel-related immobilization means that information related to this issue appear in some published guidelines on antithrombotic prevention [4, 15]. On the other hand, the level of awareness of this problem among

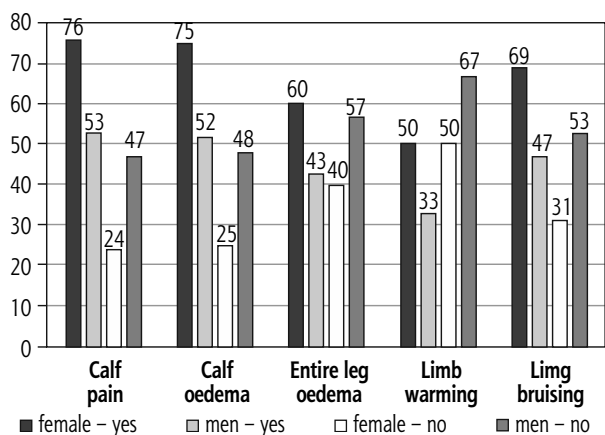
potential air travellers, as well as other forms of travel associated with chronic immobilization, remains limited. It should also be noted that in the era of the Internet, easy flow and access to information, the education of plane passengers is a rare practice, among airlines and GPs. In an attempt to answer the question about the awareness of airline passengers in terms of the risk of deep vein thrombosis, as well as the symptomatology of the disease and the possibilities of its prevention, the study attempted to assess the knowledge of the above-mentioned population in the above-mentioned scope in a survey conducted at an international airport.

## MATERIAL AND METHODS

Four hundred airline passengers took part in the study. An anonymous questionnaire was conducted with them. The inquiry was carried out at Katowice-Pyrzowice Airport with the consent of the airport authorities, between 15.02.2019 and 17.05.2019. The questionnaire consisted of 29 questions concerning knowledge about the disease, incl. symptoms, risk factors, and principles of prevention. Passengers were also asked about the connection between venous thrombosis and flight, the number of flights per year, the presence of possible symptoms in themselves, or the use of prophylaxis during the flight. There were 27 closed and 2 open-ended questions.

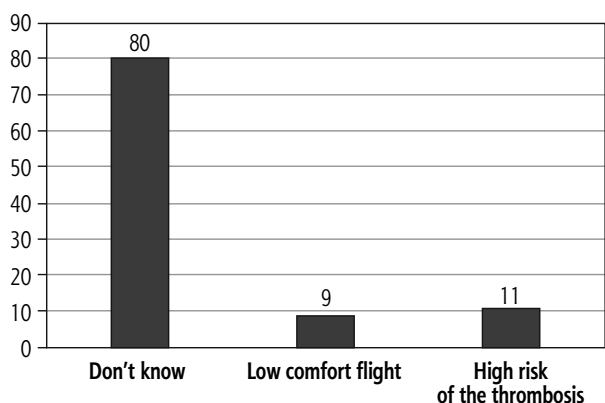
**Table 1.** Thrombosis risk level depending on risk factors (own modification based on the literature) [9–12]

Risk level	Risk factors
Low	No risk factors or: Age < 40 years from Overweight Minor surgery (up to 3 days ago)
Moderate (more than 1 risk factor)	Postpartum period (up to 2–6 weeks) Lower limb injury (up to 6 weeks ago) Age > 60 years Hormone therapy (including oral contraceptives) Varicose veins of the lower legs Obesity (BMI > 30) Presents circulatory failure Myocardial infarction (up to 6 weeks back) History of idiopathic venous thrombosis, currently untreated History of venous thrombosis after flying
High	Major surgery (up to 4–6 weeks) Extensive trauma (4–6 weeks) Immobilization in a plaster cast Cancer Cancer chemotherapy (up to 6 months) or planned chemotherapy History of idiopathic venous thrombosis, currently untreated History of venous thrombosis after airplane flight Confirmed thrombophilia

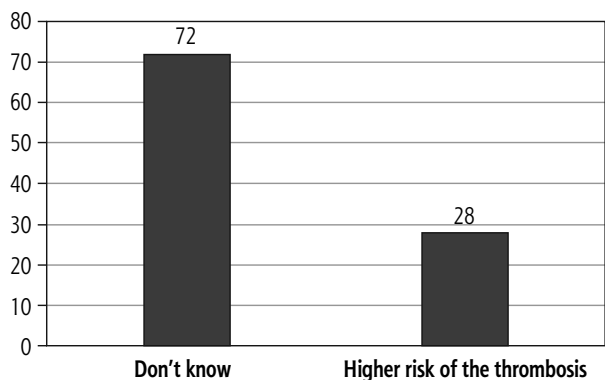


**Fig. 1.** Percentage distribution of knowledge of the respondents about potential symptoms in a patient with deep vein thrombosis

The open ones were about giving the definition of ECS and traveller’s thrombosis. The respondents were aged 18–76 years, 56% of the respondents were women, and 44% were men. The aim of the study was to determine the level of knowledge and awareness of airline passengers regarding the relation between the flight and the occurrence of venous thrombosis.



**Fig. 2.** Knowledge (understanding of the term) of the respondents about the concept of “economy-class syndrome” (%)



**Fig. 3.** Knowledge – understanding of the term travel thrombosis among the respondents (%)

## RESULTS

Eighty-four per cent of the respondents correctly defined the term venous thrombosis. Women (94%) were more aware of this, while among men the percentage of correct answers was 74%. Only 1.75% of the respondents suffered from venous thrombosis, but 16% of the respondents had the disease in the family. The existence of a relationship between a long air trip and venous thrombosis was noted by 69% of respondents, and 17% could not explain it. Fifty-two per cent of respondents confirmed the influence of the long air travel on the increased risk of thrombosis, including the following: prolonged sitting in one position, which may be conducive to blood clots, flight duration, which increases the risk, and variation of pressures and conditions in the aircraft compared to those prevailing at sea level. The respondents were also asked a question about the symptoms that occur in the event of thrombosis. Among the 5 listed, the most commonly indicated symptoms of venous thrombosis were as follows: pain in the lower leg, swelling, swelling of the entire limb, increased warming of the limb, and discoloration of the limb-bruising. The percentage results among the respondents are presented in Figure 1.

Among the results, it is worth paying attention to the disproportion in knowledge between the two sexes. The correct answer to particular questions was provided by an average of 20% more women than men.

In the next question, the lower leg problems reported by passengers in connection with air travel were assessed. Among the most common symptoms observed while traveling, the respondents reported lower leg pain (15.25%; 60.7% of which were women and 39.3% men) and swelling of the calf, reported by 13% of respondents (65.4% of whom were women and 34.6% were men). Less frequently reported symptoms were swelling of the entire limb – 5.25%, increased limb warming – 5.75%, and the rarest symptom – change in colour of the limb to bluish, reported by 2.25% of respondents.

The next two questions were related to the passenger’s definition of both “economy-class syndrome” and “traveller’s thrombosis”. Economy-class syndrome (ECS) turned out to be a term unknown to almost 89% of respondents. The answers given by the respondents can be divided into 3 categories:

- the answer “I do not know” or no answer,
- an answer suggesting reduced flight comfort,
- a correct answer,
- i.e. the association of reduced space with limb immobilization and blood flow abnormalities which increase the chance of developing deep vein thrombosis (Fig. 2).

Also, the term “traveller’s thrombosis” turned out to be unknown to the majority of the respondents (Fig. 3).

To the question about the possibility of taking preventive actions during a long flight by plane was answered by 51% of the respondents. Most of the respondents, from

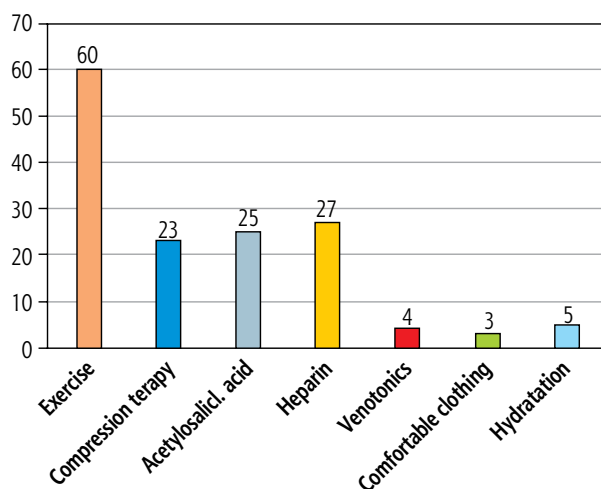
the group that answered correctly to the question (58%), indicated activities such as walking, moving during the flight, or stretching exercises, while 45% pointed out drugs, 13% mentioned aspirin, and low-molecular-weight heparin was indicated by 28% of the respondents. Compression products were mentioned as a preventive measure by 23% of those who answered this question, and only 5% indicated adequate hydration of the body (Fig. 4).

Next question about prophylaxis concerned its use by the travellers themselves. Compression stockings were used by few responders (7.5%).

The respondents were also asked if they had ever heard that before a long flight, it is best to take a drug that suppresses clotting, e.g. an aspirin tablet or an anticoagulant injection. Aspirin was indicated by 34% of the respondents and an anticoagulant injection by 27%. The knowledge of prophylactic exercises against venous thrombosis was also asked. Twenty-two per cent showed knowledge in this area. Among the exercises they mentioned were the following: movement on the plane, stretching the legs, frequent change of sitting position, and contracting the calf muscles.

The last part of the survey focused on passengers' knowledge of potential risk factors for venous thromboembolic events (VTE). Eighty-eight per cent saw a link between thrombosis and obesity. Ninety per cent of people interviewed said that longer flight distance causes thrombosis to occur more often. The distribution of responses to individual time intervals is presented in Figure 5.

When asked whether intensive sports practice in the short term before the flight increases the risk of venous thrombosis, 44% of the respondents answered in the affirmative. Seventy-eight per cent of respondents qualified the surgery before the flight as a risk factor. Multiple flights in a short period of time were considered by 64% of respondents to increase the risk of thrombosis. Congenital coagulation disorders and neoplastic disease were consid-



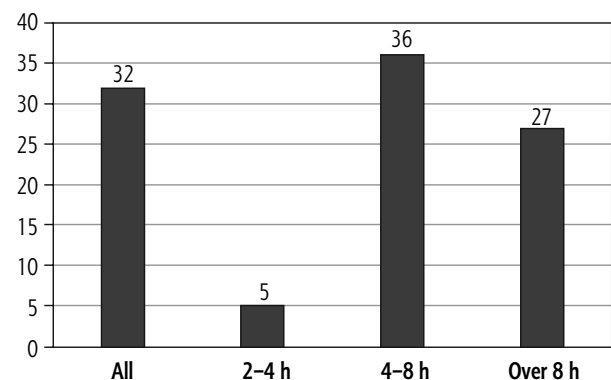
**Fig. 4.** Methods of venous thrombosis prophylaxis indicated by the respondents (%)

ered by 76% and 61% of respondents as factors causing thrombotic disease, respectively. Respondents were also asked about drugs that increase the risk of deep venous thrombosis (DVT). Seventy-six per cent of them did not know what drugs contributed to the disease, and of the remaining group 48% reported that they were hormonal drugs, contraceptives, or hormone replacement therapy. The respondents' knowledge about the influence of meals on the higher incidence of deep vein thrombosis was assessed. Sixty-one per cent answered that foods are a risk factor, with 84% saying that alcohol and/or coffee should be avoided. Only 86% were aware of adequate hydration in the prevention of thrombosis. Seventy-two per cent of respondents replied that the way of dressing reduces the risk of thrombosis, 48% of them indicated that "loose" clothing was the best. The last question was about the effect of growth on DVT; 41% of respondents replied that body height is important in causing the disease.

## DISCUSSION

In the year 2001, the WHO suggested the probability of a connection between DVT and long-haul flights; however, it was not clearly proven due to a lack of relevant data. As a result, the WRIGHT Project (the WHO Research Into Global Hazards of Travel) was launched, and the outcome of the first phase was published in 2007. It proved that a long journey is a risk factor for DVT occurrence. The project provided results which stated that in the case of healthy people travelling for less than 4 hours, the risk is 1/6000. While with the extension of the time and number of flights, the risk increases to 1/1000. The analysis published so far confirms the existence of this dependence, and thus passengers should be informed about the risk factors and the principles of its prevention [16].

An unquestionable obstacle in the implementation of these recommendations is the lack of high-quality evidence resulting from evidence-based medicine, as well as the lack of special obligation from insurers and airlines to apply appropriate antithrombotic prevention rules while travelling by plane [15, 17]. The awareness among trav-



**Fig. 5.** Knowledge of the respondents about the relationship between flight distance and the risk of venous thrombosis (%)

ellers about the connection between the onset of VTE symptoms and being on a flight is alarmingly low, and the lack of knowledge about risk factors and prevention is disturbing. The analysis of our research results showed that only 52% of passengers discern an association between long-term air travel and the onset of DVT. The knowledge of any preventive methods also oscillates around 50%, of which only 7.5% of passengers have ever used prophylaxis during the flight. These results show that despite the growing number of people travelling by plane, awareness of the risk of DVT remains low. The level of knowledge about the discussed issues among Polish travellers does not differ much from travelling French citizens. This is reflected in a study by the French Society of Phlebologists. Compared to the French citizens, understanding of the factors contributing to the risk of deep vein thrombosis, i.e. drinking, moving around onboard during the flight, and the type of clothing, was higher among our respondents. On the other hand, knowledge about the beneficial effects and the possibility of using compression therapy in the prevention of deep vein thrombosis turned out to be significantly less widespread among the surveyed Polish citizens (7%) compared to the French (77%). One third of the respondents knew the method of taking aspirin before a long flight, which according to the current recommendations is not a recommended practice, but only suggested in the absence of the other methods of pharmacological prophylaxis [18]. In the recommendations of the French Society of Angiology, 15% of the respondents declared the use of aspirin before the flight [18]. According to the document of Aviation, Space, and Environmental Medicine from the year 2001, the main risk factors which contribute to morbidity of VTE are: blood disorders affecting the tendency of clotting, and impaired blood clotting mechanism, such as a clotting factor abnormality, as well as cardiovascular diseases, current or past neoplastic disease, recent major surgery, recent trauma to the lower limbs or abdomen, previous episode of VTE or a positive family history, pregnancy, oestrogen therapy, including oral contraception, age over 40 years, and prolonged immobilisation. As can be seen from the results of the survey conducted at Katowice-Pyrzowice Airport, many of these factors remain unknown to the passengers travelling in our country, for example, the influence of drugs, especially oral contraceptives, or the influence of an active neoplastic disease. Factors related to a higher level of awareness among surveyed passengers turned out to be obesity, dehydration, and excessive alcohol intake.

The connection between the occurrence of DVT and long-haul flights was first observed by Homans in 1954, who described 2 passengers with the dependency mentioned previously herein [3]. This topic became a subject of research. In the research project LONFLIT 1 by Belcaro, 355 passengers with low risk and 389 passengers with high risk of deep vein thrombosis were followed. After

12 hours of flying within the span of 24 hours a Doppler ultrasound examination was performed. In the low-risk group, no signs of DVT were observed, whereas in the high-risk group, signs in ultrasound examination occurred among 2.8% of passengers. Those with low risk were not advised to use antithrombotic prophylaxis. This research demonstrate the importance of being familiar with risk factors, so it is possible to find passengers with high risk of occurrence of DVT and use pharmacological prevention among them [19]. According to the British Society of Cardiothoracic Surgery (BTS Guidelines), passengers should be divided into 3 groups in terms of risk of DVT after long-distance flight. DVT prophylaxis depends on the ascribed group – low, medium, and high risk. In the low-risk group recommended methods are stretching exercises, walks, and avoiding alcohol intake. For those in the medium-risk group compression therapy and alternatively low-molecular-weight heparin therapy are advised, and for high-risk patients compression therapy and LMWH [11]. Another research by Belcaro et al., LONFLIT 2, applied compression therapy in travellers. Among 833 passengers, 422 represented the control group, while 411 people used compression therapy up to 48 hours before the departure. Afterwards, within a 24-hour period including a 12-hour long-haul flight, Doppler ultrasound was performed. In the control group DVT signs were observed in 4.5% of patients, while in people using compression therapy only 0.24% presented changes in ultrasound examination suitable with DVT (1 person) [19]. The term economy-class syndrome is not known by the majority of plane travellers. This term is misleading according to the UK House of Lords Select Committee on Science and Technology guidelines; thus, they propose using the term flight-related DVT or traveller's thrombosis instead [20]. In the year 2003, the American Public Health Association have esteemed awareness of passengers about the Economy-class syndrome. From 1000 people, only 10 (1%) responded to the question, while 5 (0.5%) replied with a valid response. The rest of the responders connected the term with economy-class flight. In comparison with present outcomes, we can observe slight enhancement. Twenty per cent of the surveyed applied to explain the definition, and 3% did it correctly. In the span of 16 years, the number of flights increased significantly, and so higher awareness about health problems in the journey is expected, and the research results should arouse concern.

According to the surveys, knowledge about DVT risk factors is continually low. It is worth mentioning that in the aspect of low acknowledgment in travellers, information given by airlines plays crucial role. Among Polish hauliers there is a lack of guidebooks about deep vein thrombosis and its prevention. Contentedly, worldwide, we can observe a trend of campaigns about DVT by airlines, for example in the United Kingdom and France. It should be noticed that such information is provided on

the website of the Spanish government (Información Terapéutica Del Sistema Nacional De Salud) [21].

## CONCLUSIONS

Despite easy access to the Internet and magazines, knowledge among the travellers remains low when it comes to the connection between deep vein thrombosis morbidity and flying, similarly in terms of prevention and risk factors. It is essential to undertake large-scale and systemic actions that could enhance the awareness of minimizing the risk of DVT.

*The authors declare no conflict of interest.*

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