

Impacts and effects of the use of medications by crew and passengers during air transport

Impactos e efeitos do uso de medicações por tripulantes e passageiros durante o transporte aéreo

Impactos y efectos del uso de medicamentos por parte de la tripulación y los pasajeros durante el transporte aéreo

Received: 12/30/2021 | Reviewed: 01/04/2022 | Accept: 01/07/2022 | Published: 01/11/2022

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Abstract

During a flight, changes occur in the human body, whose possible reactions can influence the well-being and quality of health of medicine users, subject of scarce studies. The aim of this paper is to analyze the impacts and effects of medication use during air transport. Through a literature review and documentary research methodology, relevant facts about the precautions that should be taken regarding the use of medication in flights were considered. As a practical contribution, some important medications and their possible effects during flights are presented, as well as some warnings about medication interactions, and some advice for better quality air travel for the health of passengers and crew are given. As a theoretical contribution, this study gathers the scattered information presented in the literature about the problems that the use of medications during a flight can cause to the human body and possible recommendations. As social contribution, this study warns about the risks of self-medication, and establishes a basis for future discussions with society about the use of medication in flights.

Keywords: Medicines; Flight; Aeronautical industry; Aeronautical sector; Healthcare 4.0; Networks.

Resumo

Durante um voo, ocorrem mudanças no corpo humano, cujas possíveis reações podem influenciar no bem-estar e na qualidade de saúde dos usuários de medicamentos, objeto de estudos escassos. O objetivo deste artigo é analisar os impactos e efeitos do uso de medicamentos durante o transporte aéreo. Por meio de revisão de literatura e metodologia de pesquisa documental, foram considerados fatos relevantes sobre os cuidados que devem ser tomados quanto ao uso de medicamentos em voos. Como contribuição prática, são apresentados alguns medicamentos importantes e seus possíveis efeitos durante os voos, bem como alguns alertas sobre as interações medicamentosas e alguns conselhos para viagens aéreas de melhor qualidade para a saúde dos passageiros e tripulantes. Como contribuição teórica, este estudo reúne as informações dispersas apresentadas na literatura sobre os problemas que o uso de medicamentos durante o voo pode causar ao corpo humano e possíveis recomendações. Como contribuição social este estudo alerta sobre os riscos da automedicação, e estabelece bases para futuras discussões com a sociedade sobre o uso de medicamentos em voos.

Palavras-chave: Medicamentos; Voo; Indústria aeronáutica; Setor aeronáutico; Healthcare 4.0; Redes sociais.

Resumen

Durante un vuelo se producen cambios en el cuerpo humano, cuyas posibles reacciones pueden influir en el bienestar y la calidad de salud de los usuarios de medicamentos, tema de escasos estudios. El objetivo de este trabajo es analizar los impactos y efectos del uso de medicamentos durante el transporte aéreo. Mediante una revisión de la literatura y una metodología de investigación documental, se consideraron hechos relevantes sobre las precauciones que se deben tomar con respecto al uso de medicamentos en los vuelos. Como contribución práctica, se presentan algunos medicamentos importantes y sus posibles efectos durante los vuelos, así como algunas advertencias sobre las interacciones de los medicamentos y se dan algunos consejos para viajes aéreos de mejor calidad para la salud de los pasajeros y la tripulación. Como aporte teórico, este estudio recoge la información dispersa presentada en la literatura sobre los problemas que el uso de medicamentos durante un vuelo puede ocasionar al cuerpo humano y sus posibles recomendaciones. Como aporte social, este estudio advierte sobre los riesgos de la automedicación y sienta las bases para futuras discusiones con la sociedad sobre el uso de medicamentos en los vuelos.

Palabras clave: Medicamentos; Vuelos; Industria aérea; Sector aeronáutico; Salud 4.0; Redes sociales.

1. Introduction

Studies on the adverse effects of medication taken on board are limited (Roma et al., 2021; Wotring, 2015; Woting & Smith, 2020). This study discusses the impacts and effects of the use of medications in the air transport of passengers, considering issues of changes to the body during the flight and its possible reactions that influence the well-being and quality of health of its users.

Self-medication is the situation in which the patient uses medication, without medical indication or supervision, and even if the medication used is over-the-counter, they are not risk-free and can harm health (Andrade et al., 2020; Klein et al., 2020; Lázaro et al., 2020; Santos et al., 2020; Silva Filho et al., 2020). A survey carried out by the Federal Council of Pharmacy (CFF), through the Datafolha Institute, found that self-medication is a common habit for 77% of Brazilians who have taken medication in the past six months. Almost half (47%) self-medicate at least once a month, and a quarter (25%) do it every day or at least once a week (Conselho Regional de Farmácia de São Paulo, 2019).

Self-medication during the flight, however, has the potential to bring serious consequences that must be known, with the risk of the passenger suffering from the medication interaction. Anyone who uses some type of medicine such as those for chronic diseases is subject to this risk, which can have varying degrees of intensity (Da Silva et al., 2021; De Caux et al., 2021; Jacaúna & Rodrigues Junior, 2021). Some more serious cases lead to allergic reactions or even those that cause some type of unforeseen action in the body, with damage to the functioning of the organs (Voe, 2017).

After boarding a plane, many passengers take medicine to deal with the inconvenience of a long trip and fear of flying. Some use medication to sleep, while others use it to reduce anxiety, nausea and other discomforts (Voe, 2017). However, the problem is that many medications are without prescription or medical advice.

Climate parameters, air temperature, humidity, precipitation, atmospheric pressure and wind affect human health directly (sense of comfort, mortality and morbidity from systemic diseases) and indirectly (infectious diseases carried by air,

water, soil and food vectors), since the human body is in permanent contact with its atmospheric environment through exchanges of water and gas (Hinninghofen & Enck, 2006; Pitton & Domingos, 2004).

According to the International Civil Aviation Organization (ICAO, 2003, p.1), the human element is “the most flexible, adaptable and valuable part of the aeronautical system, but it is also the one that is most vulnerable to external influences that may come, negatively affecting its performance”.

Therefore, it is important to know the impacts and effects of medicines on the human body in air transport, since many people are unaware of the subject. Equally important would be for the passenger to consult his/her doctor to find out what or which medications he/she could use during the flight, as well as that in more serious health cases, airlines could be alerted in advance, so to be able to minimally prepare for any adverse situation, with respect to the health of these passengers. Pharmacists can also be consulted about the impacts and effects of medication on flights. To analyze this, the following research question is formulated:

RQ1: How can medication impact the human body during flight?

The hypothesis that guides the development of this paper is that the human body changes its reaction during a flight, and therefore the impact and effect caused by the use of medication can change during the flight.

Therefore, this research contributes to presenting the impacts and effects of medications on the human body during flight, what precautions should be taken so that that aviation can use them, as well as providing some warnings about medication interactions, and some advice for better quality air travel for the health of passengers and crew, object of limited studies, a gap in the literature that this study aims to fill.

2. Methodology

This study can be classified as qualitative and theoretical/conceptual, as it aims to seek more information about the impact and effects of medications in the human body during flight, bringing relevant information to this topic for aviation.

As for the evaluation of this research, it is considered qualitative research, according to Bryman (1989):

- It means that the researcher makes observations and collects evidence;
- Therefore, it tends to be less structured in order to capture the perspectives and interpretations of the people surveyed.

Nakano (2012) presents a typology that divides research into categories:

- Experiment – study of the relationship between two variables of a system through experimentation controlled by the researcher;
- Theoretical/Conceptual – conceptual discussions based on literature, literature reviews and conceptual modeling.

As a research strategy, bibliographic research was used, when scientific papers were consulted, in the periods from 1985 to 2021, and documentary research, where websites, magazines, reports, and official documents related to the impacts and effects of medications in the air transport of passengers were used (Martins and Theóphilo, 2009).

A literature review adapted from Tranfield et al. (2003), as illustrated in Table 1 was made.

Table 1 – Steps of the literature review.

Phases	Steps
Review characteristics	1. Identification of the need for literature review 2. Development of a literature review protocol
Screening	3. Identification of documents 4. Selection of relevant documents
Analysis and synthesis	5. Document categorization 6. Data extraction
Result	7. Conclusion

Source: Adapted from Tranfield et al. (2003).

2.1 Databases search results

PubMed, Scopus and Web of Science were consulted using the search string in the Title, Abstract and Keywords, without any filter initially. The total number of studies identified in each database is shown in Table 2.

Table 2 – Number of studies identified.

Search string	PubMed	Scopus	Web of Science
Aerospace OR Aeronautic* OR flight OR “air transport” OR airplane OR plane OR airline OR aviation	288,602	1,607,634	1,589,452
Medication OR drug OR medicine OR remedy OR medicant	14,823,190	10,538,253	17,314,134
Health OR body OR human OR passenger OR crew	22,511,884	26,891,675	14,174,011
(Aerospace OR Aeronautic* OR flight OR “air transport” OR airplane OR plane OR airline OR aviation) AND (Medication OR drug OR medicine OR remedy OR medicant) AND (Health OR body OR human OR passenger OR crew)	72,941	42,648	54,016
(Flight OR “air transport” OR airplane OR aviation) AND (Medication OR drug OR medicine OR remedy OR medicant) AND (passenger OR crew)	2,128	2,694	1,932
(Flight OR “air transport” OR airplane OR aviation) AND (Medication OR drug OR medicine OR remedy OR medicant) AND (passenger OR crew) AND (contraindication OR interaction)	100	111	81
Total			292

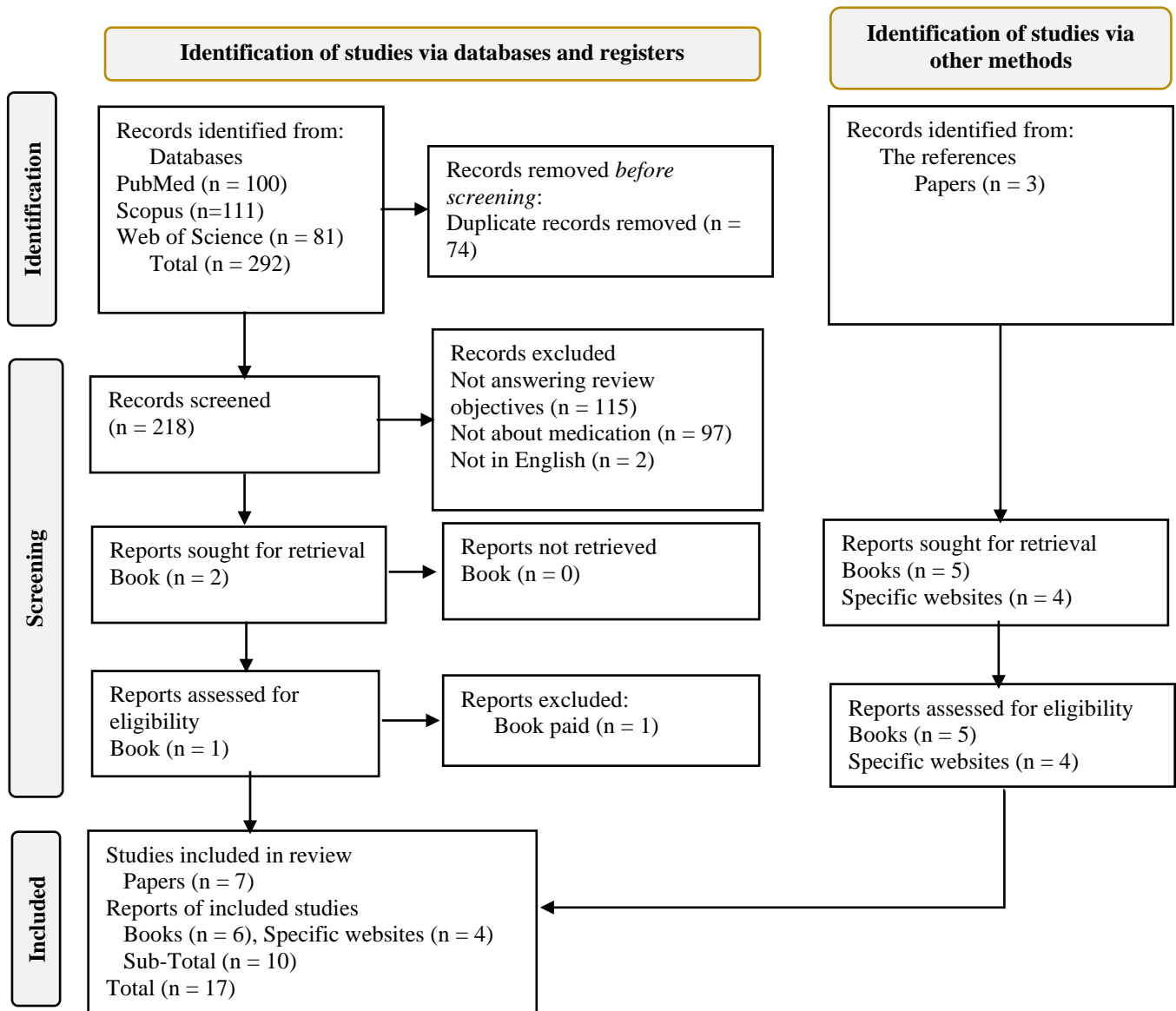
Source: Elaborated by the authors (2021).

Of the total of 292 documents, 74 were removed because they were duplicate documents. After reading the remaining 218 documents, only 4 papers were selected, and another 3 papers identified from the references were included in a total of 7 papers. A book identified in the databases and another 5 identified in websites and references were also included, in addition to 4 specific aviation websites, totaling 17 documents, from 1985 to 2021. This attests the rarity of studies in this area.

In order to guide the identification, selection and inclusion process, this study used the new Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) flow diagram template, an improvement of the 2009 model, the PRISMA 2020 (Page et al., 2021), although this study is not a systematic review. Figure 1 shows the process.

PRISMA 2020 brings a novelty, introducing reports and record. Report is considered any document (electronic or paper) that provides relevant information, such as unpublished manuscript, conference abstract, preprint, dissertation, clinical study report, government report, journal article and others. Record is considered the abstract or title (or both) of a report indexed in a website or database (such as a paper indexed in Medline).

Figure 1 - PRISMA flow chart of papers screening and selection process.



Source: Adapted from Page et al. (2021).

3. Results and Discussion

Aviation is considered a model organization in terms of security. Its workers operate in a complex system, with countless interfaces between people and technology, and yet it has extremely low accident rates. Aeronautical accidents are rare, highly visible and give rise to exhaustive investigations to find out everything that involved the accident, with the main purpose of learning from mistakes and avoiding other accidents. In contrast, medical errors are mostly barely visible, underreported, and there are no standards or methods of investigation and documentation (Leape, 1999). The knowledge obtained from the study of the error that occurred is not disseminated (Helmreich, 2000).

According to Guyton and Hall (2006), one of the effects impacted by high heights is the low oxygen pressure on the body. This decrease in barometric pressure is the root cause of all hypoxia problems in physiology of the human body, due to the ratio of barometric pressure to the partial pressure of oxygen in the atmosphere decreasing.

Another possible change is dizziness such as a mild headache, or any vague and sporadic feeling of fainting, and also lack of strength. However, only true dizziness, which many consider to be vertigo, causes a sensation of movement or rotation.

It can be that, momentary or last for hours or even days. The person with vertigo usually feels better if they lie down and remain immobile: however, the vertigo can continue even when they are completely still (Guyton; Hall, 2006).

The concepts about accidents that occur with medications are described below. It should be noted that the terminology presented is currently the most accepted, and cannot be taken as definitive given the controversy that still arouses. "Medical accidents" are all unexpected or predictable incidents, problems or failures, produced or not by error, consequence or not of malpractice, imprudence or negligence, which occur during the process of using the medications; this concept encompasses the entire sequence of technical or administrative procedures, whether or not they cause harm to the patient (Leape, 1999; Manasse, 2006). Medication accidents are therefore all "adverse events" related to medications, which, in turn, are divided into "adverse reactions" and "medication errors" (Manasse, 1998).

This list of contraindicated medications for aeronauts and air transport passengers is also a reminder that the traditional habit of self-medication remains prohibited and must be used only under the guidance of the doctor and pharmacist.

Here are some contraindicated medications for aeronauts, according to Helfenstein (1998):

- **Analgesics, antipyretics (pain, colds, flu)**
Unwanted effects: drowsiness and decreased reflexes.
Consequence: not allowed to fly for eight to twelve hours.
- **Anti-allergy**
Unwanted effects: drowsiness and decreased reflexes.
Consequence: not allowed to fly for twelve to twenty-four hours.
- **Antacids and digestives**
Unwanted Effects: Visual changes.
Consequence: not allowed to fly for eight to twelve hours.
- **Effervescent**
Undesired effects: increase the amount of gas, increase abdominal distension.
Consequence: not allowed to fly for six hours
- **Nasal decongestants**
Topics (cream, ointment and lotion).
Unwanted effects: adrenergic and mucosal damage.
Consequence: aggravated by activity, middle ear problems.
Systemic
Unwanted effects: drowsiness and decreased reflexes.
Consequence: not allowed to fly for twelve to twenty-four hours.
- **Anti-diarrheas (opiate derivatives):**
Unwanted effects: drowsiness and altered reflexes; mask the etiology.
Consequence: not allowed to fly for twelve to twenty-four hours.
- **Antibiotics and bactericides:**
Unwanted effects: dysbacteriosis with diarrhea or gastric problems, nausea and other complications.
Consequence: not allowed to fly until the end of treatment.
- **Tranquilizers, hypnotics:**
Unwanted effects: decreased reflexes, drowsiness.
Consequence: not allowed to fly for twenty-four hours.

- **Anorectics, stimulants:**
Undesired effects: alteration in soil, appetite and reflexes.
Consequence: not allowed to fly for twenty-four hours.
- **Local anesthetics:**
Undesired effects: changes in reflexes and bradycardia.
Consequence: not allowed to fly for twelve hours.
- **Diuretics:**
Unwanted effects: increase fluid loss, dehydration, potassium loss.
Consequence: not allowed to fly for twelve to twenty-four hours.
- **Antihypertensives:**
Undesired effects: change in heart rate, hypotension, drowsiness and decreased reflexes.
Consequence: not allowed to fly for twelve to twenty-four hours.
- **Non-hormonal anti-inflammatory and anti-colic:**
Undesired effects: gastric problems and drowsiness with decreased reflexes.
Consequence: not allowed to fly for twelve to eighteen hours.

Here follows some medications, adapted from the study proposed by the lieutenant doctor Eduardo Serra Negra Camerini (1988), in his work called Practical Guide to Self-medication, and adapted from Helfenstein (1998), following the suggestion of dividing the medicines into six groups:

- **Group 1:**

Medications that will normally be safe to be taken while flying, provided that in normal doses and for a short period. Table 3 presents a list of some medications name of the substance or active ingredient (trade name and use).

Table 3 - Active ingredient or substance (trade name).

Substance (trade name)
Acetaminophen / Paracetamol (Tylenol - Analgesic, Antipyretic)
Calcium carbonate (Calcium Sandoz - Prevention and treatment of calcium deficiency)
Vitamin C (Redoxon, Cebion - Prevention and treatment of vitamin C deficiency);
Benzalkonium Chloride, Sodium Chloride (Rhinoserum - Nasal Decongestion)

Source: Adapted from Camerini (1988) and Helfenstein (1998).

- **Group 2:**

Medications that the aeronaut can use and fly, after consultation with the aviation doctor for approval. Table 4 presents a list of some of these medicines, some of which are antibiotics/antimicrobial, psychotropic and reference, with name of the substance or active ingredient and trade name (and type of medicine).

Table 4 - Active ingredient or substance (trade name).

Substance (trade name)
Amoxicillin (Amoxil, Hiconcil - Antibiotic)
Carbenicillin (Carbenicillin - Antibiotic)
Chloroquine or Chloroquine Phosphate (Aralen, Reuquinol - Psychotropic)
Nystatin (Miconstatin - Antifungal)
Methyl-testosterone (Pasuma - Anabolic and Antineoplastic - Psychotropic)
Metronidazole (Flagyl - Antimicrobial)
Tetracycline (Tetrex - Antibiotic)
Betamethasone valerate (Betnovate -Anti-inflammatory Lesion - Reference)

Source: Adapted from Camerini (1988) and Helfenstein (1998).

- **Group 3:**

Contains medications that an aviation doctor can approve for use in flight after reviewing the individual history. Table 5 presents the list of some drug names of the substance or active ingredient (trade name and use).

Table 5 - Active ingredient or substance (trade name).

Substance (trade name)
Acetazolamide (Diamox - Glaucoma)
Allopurinol (Ziloric - Gout / Uric Acid)
Hychlorothiazide/Chlortadilone (Higroton, Chlorane - Diuretics)
Cimetidine (Tagamet, Stomakom - Ulcers)
Clofibrate (Atromid - Cholesterol, Triglycerides)
Griseofulvin (Grifulvim - Dermatophytosis treatment)
Propranolol (Propranolol, Inderal - Anti-hypertensive, anti-arrhythmic, anti-sick, anti-tremor)
Thyroglobulin (Proloid - Thyroid Cancer)

Source: Adapted from Camerini (1988) and Helfenstein (1998).

- **Group 4:**

Contains those medications that have an adverse effect on the pilot. Thus, it will not be allowed to fly while the medication is in his/her body at concentrations greater than what it would be when three half-lives had passed (half-life is the time required for the concentration of a given substance to drop by half). Table 6 presents the list of some drug names of the substance or active ingredient (trade name and use).

Table 6 - Active ingredient or substance (trade name/half life).

Substance (trade name/half life)
Aminophylline (Marax, Aminophylline / 4 hours - Bronchial asthma and bronchospasm)
Codeine (Belacodid, Setux/4 hours - Analgesic and anti-secretory)
Dimenhydrate (Dramamine, Dramin/8 hours - Nausea, vomiting and vomiting)
Phenobarbital (Gardenal/6 days -Barbiturates, anticonvulsants)
Prednisolone (Deltacortril/8 hours - Endocrine, musculoskeletal, rheumatic, collagen, dermatological, allergic, ophthalmic, respiratory, hematological, neoplastic)
Tinidazole (Pletil/13 hours - Gastrointestinal, post-operative gynecological)

Source: Adapted from Camerini (1988) and Helfenstein (1998).

- **Group 5:**

Contains medications that prohibit the pilot from flying while using them, due to the fact that the pathologies for which they were prescribed prevent a safe flight. Table 7 presents the list of some drug names of the substance or active ingredient (trade name and use).

Table 7 - Active ingredient or substance (trade name).

Substance (trade name)
Phenindione (Dindevam - Anticoagulant)
Biperoden (Akineton - Parkinson)
Caffeine, Ergotamine (Ormigreïn, Cafergot-Imigrans - Migraine)
Carbamazepine (Amplictil - 6-copene - Seizure, epilepsy)
Lanatoside-C (Cedilnade – Acute and chronic congestive heart failure)
Insulin (Insulin - Diabetes)
Nitrates (Isordil – Cardiac ischemic “angina”, acute and chronic congestive heart failure)
Chlorpropamide (Diabinese - Blood Glucose, Diabetes)
Meperidine (Dolantine-Demerol - Opioid Analgesic)

Source: Adapted from Camerini (1988) and Helfenstein (1998).

- **Group 6:**

Contains extremely potent medications. At least five half-lives must pass before the pilot resumes his activities. Table 8 presents the list of some drug names of the substance or active ingredient (trade name and use).

Table 8 - Active ingredient or substance (trade name / half-life).

Substance (trade name/half life)
Amphetamines (Hypogaph/8 hours - Psychostimulants)
Carisoprodol (Dorilax-Miocitalgam/2 hours - Analgesic, muscle relaxant)
Diazepam (Diempax- Valium/48 hours – Benzodiazepines, anxiolytic, tranquilizer)
Ibuprofen (Motrim/6 hours - Non-steroidal anti-inflammatory)
Chlordiazepoxide (Psychosedim/24 hours - Anxiolytic)
Indomethacin (Indocid/13 hours - Anti-inflammatory - non-steroid)

Source: Adapted from Camerini (1988) and Helfenstein (1998).

In summary, medications are chemicals that alter the body that must be taken properly, always with the guidance of the doctor and pharmacist. The information of these medicines contraindicated to aeronauts and passengers can be changed and added as injectable medicines as well as more specific medicines are used.

As there are restrictions to a series of allopathic medicines, alternative medicine is often sought, so that aeronauts and passengers can receive better therapeutic guidance, enabling a more adequate treatment. Among the alternatives are oriental medicine (acupuncture, Do-In, Shiatsu, etc.) and homeopathy (Helfenstein, 1998).

Just as an illustrative fact, Table 9 represents the most used homeopathic remedies in aerospace medicine and their therapeutic indications (Helfenstein, 1998):

Table 9 - Substance homeopathic remedies (effects on the body).

Substance (effects on the body)
Alumina (effect of dryness on board)
Berberis aquifolium (dry skin in flight)
Borax (fear of landing)
Dulcamara (increased sensitivity to hot/cold change)
Fucus Vesiculosus (evacuate, lose weight)
Canadian Hydratis (sinusitis);
Kali muriaticum (chronic ear problems (Eustachian tube) from flight)
Kali phosphoricum (flight fatigue)
Lac defloratum (sickness on board)
Lycopodium (acid and very flatulent dyspepsia)
Platinum (Aeronaut's constipation)
Sanguinarinum nitricum (Aviators' pharyngitis)

Source: Adapted from Helfenstein (1998).

3.1 The effects on the health of the passenger and crew during the flight

The planes sail at an altitude of 30,000 to 40,000 ft (9,150 to 12,200 m), just comparison, Mount Everest is 8,850 m high, with the pressurization inside the cabin, the feeling inside the aircraft is like being on top of a mountain at 2,000 m high; because of this, the human body has less oxygen available to breathe. In addition to being rarefied, the air is dry, with a relative humidity around 10% to 30%. Therefore, the body presents reactions to adapt to this new environment (Hinninghofen & Enck, 2006; Hocking, 1998; Monolito Nimbus, 2013).

Table 10 presents how the body behaves during a flight, presenting some human organs / vital signs that can be affected in a regular flight.

Table 10 – How the human body behaves.

Human organ / Vital signs	Body behavior
Blood pressure	The stress resulting from the sum of factors such as airport, plane environment and attitude can decompensate blood pressure. It is recommended to travel with normal and stable pressure, keep the use and schedule of medications for those who take.
Circulation	Long-term immobilization, added to predisposing factors, can cause or contribute to the occurrence of a thrombosis event, in flights lasting longer than four hours. Some precautions are to wear light clothing, move your ankles and feet, drink plenty of fluids, wear elastic stockings and avoid the use of alcoholic beverages, coffee or sleeping pills during the trip.
Nose	Pressure changes on board, going up or down, can cause problems in the frontal, maxillary and ethmoid sinuses. Normally, air enters and leaves these cavities through the nose, with which it connects, and blocking its openings in colds, sinusitis and allergic conditions can produce severe pain during takeoff and on landing. People with severe colds, flu and sinusitis should be discouraged from air travel.
Teeth	Dental treatments such as root canals can cause problems during flights, as a result of the expansion of the air in the mouth causing severe pain.
Heart	Altitude can be a problem for patients with cardiovascular disease as it exacerbates the oxygen shortage. Cardiac patients should make sure there is enough medication for the entire trip and carry it in their carry-on luggage.
Abdomen	The gas contained in the abdominal cavity expands due to the decrease in atmospheric pressure inside the aircraft cabin (aero dilation), which leads to discomfort, pain or excessive flatulence. The situation can be minimized by eating lighter foods on the eve of the trip.
Stomach	The people most susceptible to seasickness during the flight are those who have already had the same symptom when traveling by bus, car or ship. Therefore, one should avoid excessive intake of liquids, fatty foods, condiments and sodas, in addition to taking care to sit close to wings and windows. As prophylaxis, anti-sickness medications can be used.
Ears	When the aircraft starts its ascent, clicks are heard that are repeated with a certain frequency and there may be an equalization process between the pressures of the environment and the organism and, consequently, between the external ear and the middle ear. It may be necessary, with the mouth closed, to plug the nostrils and force the air to move against the temporary nasal obstruction to open the valves and allow access.

Source: Adapted from Hinninghofen and Enck (2006), and Saúdeplena (2014).

Aeronauts are subject to several risks, such as noise, vibration, low air humidity, oxygen partial pressure and other factors that can affect their bodies in the long term. Here follows the effects on the health of the passenger and crew during the flight (Hinninghofen & Enck, 2006; Monolito Nimbus 2013).

3.1.1 Physical changes

3.1.1.1 Breathing

With less oxygen, breathing becomes more difficult, which can lead to mild headaches. Passengers with asthma or other respiratory problems should be on the lookout for flare-ups.

3.1.1.2 Ears

Especially during takeoff and landing, there is a great variation in atmospheric pressure inside aircraft, which can cause the ear drums and ears to become clogged. Children are most affected by this disorder.

3.1.1.3 Mucous (eyes, nose and skin)

After six hours of flight, the relative humidity of the air can reach 10% (in the desert of the Sahara, the relative humidity varies from 14% to 20%). This leads to dryness of the skin, which can lead to nose bleeds and cause eye irritation on longer journeys.

3.1.1.4 Digestive system

During flight, air expands in all body cavities, mainly affecting the stomach and intestines. There is a risk of bouts of flatulence and swelling of the abdomen.

3.1.1.5 Legs and feet

Sitting for many hours can lead to decreased blood flow back from the calves to the heart. As a result, sedentary, obese or in poor health passengers are more likely to develop thrombosis.

3.1.2 For a healthier trip

- Try to sleep well before your flight.
- Postpone your trip if you don't feel well.
- Reserve a seat near the wings if you suffer from motion sickness.
- Take your regular medications with you.
- Travel in comfortable shoes and clothes, bring a warmer for the cold feeling inside the plane.
- Eat light meals before your flight.
- Drink water or juices during the flight, avoid fizzy and/or alcoholic drinks.
- Leave free space in front of your seat so that you can move and stretch your legs during the flight.
- Get up and periodically ride on longer flights.

3.1.3 During flight

Here follows some other examples of effects that occur in the body during flight.

• Mental confusion:

When taking sleep medications during the flight, it is quite common for the effect to be intense to the point of causing difficulty in attention and even mental confusion upon awakening. It is not uncommon to see people waking up not knowing where they are, which can lead to security problems if the person is aggressive.

Even after getting off the aircraft, light dizziness and lack of motor coordination can occur, which impairs movement (Voe, 2017).

• Medication interaction:

With self-medication during the flight, there is also the risk of the passenger suffering from medication interaction in some situations, the interaction only cuts off the effect of one or all of the medications, leading to the resumption of treatment (Voe, 2017).

• Feeling sick and faint:

Many people take medication during a plane trip with the intention of feeling relief and well-being, even more during turbulence. However, when self-medicating there are great chances that the effect is exactly the opposite. Headaches, nausea, gastric and intestinal problems are just a few side effects. Thus, instead of the trip being calm and pleasant, it is permeated by a continuous feeling of malaise, which leads to vomiting, fainting and even the need for medical attention (Voe, 2017).

- **Self-medication during the flight**

When self-medicating without being trained to do so, the passenger has no way of knowing what the effects of the components on his/her body will be. With the addition of conditions such as different air pressure, self-medication during flight can put your health at serious risk.

More severe cases can lead to respiratory failure, sudden drop or rise in pressure, cardiac arrhythmia and even stroke.

Depending on the dose and the interaction between elements, one of the possible outcomes is a state of coma, and without proper assistance, death.

Self-medication during the flight has the chance to cause anything from mild inconvenience to serious health problems. Therefore, it is essential to have professional support before taking any medication (Voe, 2017).

- **Pressure changes**

During takeoff and when the aircraft is ascending, the reduction in air pressure in the cabin causes gases to expand. Contained gases can expand by more than 25% above sea level. When the aircraft descends, the volume of gas decreases. Air trapped in areas of the body such as paranasal sinuses, ears and intestines can cause discomfort (Emirates, 2020; Hinninghofen & Enck, 2006).

To reduce the effects of this pressure, change on the body, avoid fizzy drinks and foods that produce gas such as beans and cabbage, and avoid sleeping during the last hour of the flight so you can yawn, swallow or 'unclog your ears' to equal the pressure as the aircraft descends (Emirates, 2020).

The risk of ear and sinus problems is greatly increased if the passenger is congested or 'clogged' because of a cold. It is advisable to postpone the flight if you are sick or talk to your doctor because decongestant medications can also help (Emirates, 2020; Hinninghofen & Enck, 2006).

- **Sickness/dizziness:**

Seasickness is caused when the body's balance does not match what is seen and can worsen during periods of turbulence. If the passengers are prone to seasickness, Emirates (2020) recommends by that:

Request a window seat, over the wings;

Avoid drinking alcohol before and during the flight;

To avoid dehydration, drink enough water before and during the flight;

Eat small, unseasoned meals;

Wear cool, comfortable clothing;

Keep your eyes fixed on the land, sea or horizon if the weather is clear;

Focus on an activity and keep your brain active, but avoid reading if it tends to make your symptoms worse;

Locate the seasickness bag when you sit down and keep it handy;

Discuss the use of appropriate medications with your doctor. There are many over-the-counter remedies that can be used.

- **Food and drink:**

Digestion slows down when the body is inactive, so light meals make flying more comfortable. Also, it is better to avoid excess alcohol and caffeinated beverages such as coffee and tea, as they act as a diuretic and this increases the need to go to the bathroom. Prefer frequent consumption of juices and water to maintain adequate hydration (Emirates, 2020).

- **In-flight exercises:**

To relax during and after a long flight, try doing these exercises in your seat (also available in the inflight magazine) at regular intervals (Emirates, 2020):

Rotate your feet: Rotate your feet at the ankles, 20 times each foot.

Buttock Lifts: Lift the buttocks off the chair, contracting the muscles on each side. Count to 5. Repeat 5 times on each side.

Knee Compression: Compress your knees and thighs together and tighten your buttocks muscles. Count to 5. Repeat 5 times.

Back Compression: Compress your lower back into the seat and let your shoulders come forward. Alternate with shoulder compression into the seat. Repeat 5 times.

Shoulder circular movements: With your arms at your sides, circle your shoulders forward 10 times and back 10 times.

Circular Head Movements: Make slow circular movements with your head in one direction and then the other. Repeat 10 times.

Toe Press: Raise your heels and press your toes into the floor, then lift your toes and press your heels into the floor. Repeat 10 times for each foot.

- **Cabin air quality:**

Modern aircraft are quiet and comfortable, with excellent levels of ventilation. It has been proven that the air exchange rate in the aircraft cabin is better than that of office buildings and trains and is comparable to that detected in hospital operating rooms (EMIRATES, 2020).

In addition, smoking is prohibited on all flights, so the level of airborne pollutants is much lower than on the streets or buildings of most cities. Clean air is constantly added to recycled air through very fine High-Efficiency Particulate Air (HEPA) filters to remove 99.997% of all dust, viruses, fungi and bacteria.

However, the air in the cabin has low humidity levels, which can cause slight dryness of the skin, nose, throat and eyes. To minimize the effects of dryness:

Avoid alcohol and caffeinated beverages;

Remove contact lenses and wear glasses during the flight;

Use a skin moisturizer.

- **Deep vein thrombosis (DVT)**

Deep Vein Thrombosis (DVT) occurs when a blood clot forms in the lower leg. It's not dangerous unless the clot breaks down and gets to the lungs. Immobility is the biggest risk factor for DVT and can occur after traveling by car, bus, train, plane or even after sitting in the cinema (EMIRATES, 2020; Hinninghofen & Enck, 2006).

In fact, an international report by the World Health Organization (the WRIGHT report) has shown that there is no increased risk for healthy air travelers compared to immobility of the same duration on other modes of transport. Follow these general guidelines for in-flight comfort and reduced risk of DVT (Emirates, 2020):

Wear loose, comfortable clothing;

Place your luggage in the luggage compartments above the seats, not under the seat in front of you. This will allow you to periodically stretch and exercise your feet and ankles;

As immobility is an important risk factor in the onset of DVT, it is advisable to do the recommended sitting exercises regularly and take the opportunity to stretch when going to and from the bathroom;

Stay well hydrated with regular intake of juices and water and avoid alcohol and caffeinated beverages;

Some people are more likely to have Deep Venous Thrombosis (DVT) than others. The known risk factors associated with DVT are (Emirates, 2020):

Age over 40;

Recent major surgery or injury, especially in the lower limbs or abdomen;

Recent immobilization for a day or more;

Previous family or personal history of DVT (Deep Venous Thrombosis);

Disorders with formation of blood clots;

Some forms of heart disease;

Previous or current history of malignant disease;

Hormonal treatment including oral contraceptive and hormone replacement therapy;

Pregnancy;

Smoking;

Obesity;

Varicose veins.

If the passenger has any of these risk factors, he/she should seek medical advice before traveling and discuss possible medical precautions:

Wearing appropriate socks or socks for flight;

Use anticoagulant medication or other pre-flight prophylactic measures.

Glaser and Cohen (1987) suggest a medical kit to be used on board, with a table of medications, informing: action, administration, dosage indication and contraindications, but the study is limited to this. Much of the information cited on the impacts and effects of medication use of during the air transport of passengers is poorly disclosed. The National Civil Aviation Agency of Brazil (Agência Nacional de Aviação Civil – ANAC, 2020) created a document describing measures to contain the advance of COVID 19 for air transport; the website of the Federal Senate of Brazil informs about the rights of air passengers (Senado Notícias, 2005); the São Paulo Consumer Protection and Defense Foundation (Procon) edited the Boa Viagem Project, with guidelines on vacations and how to enjoy travel (Procon-SP, 2019), but none of these initiatives is commented on the use of medication during the flights. With the support of the Federal Council of Medicine, the Faculty of Medical Sciences of Santa Casa de São Paulo, launched in 2011 the Aerospace Medicine Primer entitled “Doctor, can I travel by plane?” (2011), however it is not available at the check-in counters, even for consultation.

4. Conclusion

The impacts and effects of the medications use in flight were presented here. This study sought to show what these effects are and what precautions people should have with the use of medications.

The theoretical contribution and originality of this study is to gather the scattered information presented in the literature about the problems that the use of medications during a flight can cause to the human body and possible recommendations, subject of scarce studies.

It was noted that passengers, especially Brazilians, mostly use medicines without medical advice, and most of them

are unaware of the interaction that occurs with the medicines in the human body. As a practical contribution, some important medications and their possible effects during flights are presented, as well as some warnings about medication interactions, and some advice for better quality air travel for the health of passengers and crew are given.

Currently, airlines are not concerned about the health conditions of passengers with serious illness, as well as elderly people with heart and/or other health problems, children and pregnant women, when they buy an airline ticket.

The suggestion is that airlines transmit the information presented in this and other technical studies in the form of: leaflets, guides, manuals, booklets, on the airline ticket itself, airlines websites, check-in notices, as ways to alert about the use of medications on board, benefiting the well-being of passengers and crew, thus bringing more safety and tranquility to air travelers. Another suggestion is to ask passengers during the flight booking to answer questions about the use of medications, and depending on their answers, ask them to consult their regular doctors to support them on the air trip, and/or direct them to specific pages on the website airline, designed to assist medications users. Other suggestion is that the medications inserts can inform about the indications and contraindications for using modifications on air flights, in order to make patients, physicians, pharmacists, nurses and other medical professionals more aware of the subject.

These suggestions are opportunities to provide better safety and preservation of the health of passengers and crew in flight.

Therefore, the contribution of this study to society is to stimulate the debate, to more widely disseminate the information on the impacts and effects of the use of medication on flights, so that passengers and crew can have a better quality of life during the flight. It is suggested that there is greater focus on the subject, so that ANAC, the Brazilian Airport Infrastructure Company (INFRAERO), aviation companies, Federal and Regional Councils of Pharmacy and Medicine can better discuss the problem, in order to provide safer conditions for the use of medication during flights.

This study was based on bibliographic and documentary research, lacking case studies on the effects of medications, a limitation of this study, being a suggestion for future analyses.

As recommendations for future studies, it is also suggested to expand the range of medications studied, and the respective precautions that users should have when using medication during flights.

Acknowledgments

Our gratitude to Mrs. Dinan Dhom Pimentel Sátyro for providing linguistic help.

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