



Trainer Manual OaC:mygoal

Physical Activity for Cancer Patients



Contact

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OUTDOOR AGAINST CANCER gUG

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Forward

The OaC:mygoal trainer manual contains experiences from research about cancer and sports, from teaching at universities and workshops and from instructing people in the cancer aftercare but also from training with cancer patients in the OaC training groups.

All of the information is based on scientific research and has been investigated accurately. It has also been critically reviewed in view of the question of “what is purposeful in the chosen context and what can be practically achieved”. Thus, the manual contains a lot of transnational information. Some country-specific content from Germany is also given, that serves as an example. However research about content of each particular country needs to be done by the OaC:mygoal trainer individually.

Timeliness of data is important for any manual. That in mind even though all the information and even current examples are presented within this manual, there might be the need to offer current references for a better understanding for each country individually.

We wish all of the OaC:mygoal trainers a successful education and hope that you will help spreading the spirit of OaC.

Your OaC:mygoal Team Germany

Exemplary timetable

ARRIVAL

| | |
|---|--|
| 10:00-11:00 INTRODUCTION OaC: What is it? | Introduction of Instructor / Trainers / Partners OaC: Why is it important and what is it important for? What is special about OaC? What are the plans? |
|---|--|

11:00-11:15 BREAK

| | |
|-------------------------------|--|
| 11:15-13:00 THEORY BLOCK 1 | CANCER: Definitions, Differentiations, Categorization, Tumors, Types of Cancer, Statistics, Pathogenesis, Metastasis, Causes, Influential Factors, Prevention, Physical Activity as a Prevention |
|-------------------------------|--|

13:00-14:00 LUNCH

| | |
|-------------------------------|--|
| 14:00-15:00 THEORY BLOCK 2 | Psyche, Quality of Life, Fatigue, Cancer and Sports, Measures during Therapy, the Right Intensity, Practical Recommendations, Indications/Contra-Indications |
|-------------------------------|--|

15:00-15:15 BREAK

| | |
|---|---|
| 15:15-17:15 PRACTICAL SESSION OUTDOOR | e.g.: Functional Training Sports-specific Training; Execution of a Training Program under complicated circumstances, Dos and don'ts when training with cancer-patients |
|---|---|

17:15-17:30 BREAK

| | |
|-------------------------------|---|
| 17:30-18:30 THEORY BLOCK 3 | Legal requirements, Organisation, Implementation of OaC |
|-------------------------------|---|

19:00 Maybe group dinner/ free time for discussions

Exemplary timetable

7:30-08:30 BREAKFAST

| | |
|--|--|
| 08:30-12:00 OUTDOOR PRACTICAL SESSION | Hike with relaxation methods (Autogenic Training, Breathing Exercises,..) Mental-training Nature as a motivator for physical activity Nordic Walking and related exercises |
|--|--|

12.00-13.00 MITTAGESSEN

| | |
|-------------------------------|--|
| 13:00-14:30 THEORY BLOCK 3 | Communication, Recovery und Regeneration |
|-------------------------------|--|

14.30-14.45 COFFEE-BREAK

| | |
|-------------------------------|---|
| 14:45-16:00 THEORY BLOCK 4 | TEST (mainly Multiple Choice + 1-3 open questions) Feedback |
| 16.00 | END |

Introduction

How to best structure a workshop?

At first, the OaC:mygoal trainers should get to know the participants. Therefore the trainer is encouraged to introduce him-/herself to the group and afterwards each participant should do the same. There should be a certain structure to the introduction, which allows for a better classification of the participants.

| Questions | Content |
|------------|---|
| Why... | ...are you here? ... are we here? |
| What... | ... do you expect from this workshop? ... what do we expect? |
| How... | ...would you like to stay in contact with OaC after the course is done? ... is this to be done? |
| What if... | ...you will instruct a group on your own? ... everybody saw how important this subject is? |

Memo: The instructor asks questions and starts the introduction.

What is the background of the participants? Occupation, experiences in the topic, personal or family history of cancer, ... ?

Introduction

How to get started into the topic of cancer?

For example: Celebrities, who suffer(ed) from different types of cancer or even died from the disease:

For example: Kylie Minogue, Anastacia, Christina Applegate, Angelina Jolie, Petra Thaller (picture below) ? What do these women have in common, what differences are there? ? Characterization



Male examples: Michael Douglas, Ben Stiller, Telly Savalas, Patrick Swayze,...

Memo: Examples and pictures should be collected and included by trainers of each country.

Take home: They all have different types of cancer, different courses of the disease and different outcomes ? cancer ≠ cancer ? Some survive (5,6,7,10 years), others don't

Introduction

Memo: What does it all mean?

- What exactly is cancer and can anything be done against it?
- The latter: yes ☒ physical activity ☒ that is why we are here

That physical activity plays a role in the prevention of many cancers is well known, as is the role of exercise in decreasing treatment side effects, speeding recovery after a cancer diagnosis, and enhancing survival. Observational studies show substantial evidence that higher levels of physical activity are linked to reduce the risk of a variety of cancer types:

- Colon cancer
- Breast cancer
- Endometrial cancer



Pict. 1: Correlation of cancer risk and physical activity

Introduction – About Cancer

Terms and definitions

– Cancer

A group of diseases, which cause cells in the body to change and grow out of control. Most types of cancer cells form a lump or a mass called tumor. Not all tumors are cancer. A tumor that is not cancer is called benign, while a cancerous tumor is called malignant. A cancerous tumor can invade and destroy healthy tissue. Cells can break away from the cancer and travel to other parts of the body. There they can continue to grow. This spreading process is called metastasis. Cancer that spreads is still named after the part of the body where it started. For example, if colon cancer spreads to the liver, it is still colon cancer, not liver cancer. Benign tumors do not grow and spread the way cancer does. They are usually not life threatening. Note that some types of cancer, such as blood cancers, do not form tumors. They can still threaten life by crowding out normal cells. See also benign, malignant, metastasis, tumor.

– Tumor

An abnormal lump or mass of tissue. Tumors can be benign (not cancer) or malignant (cancer).

(Source: American Cancer Society)

Introduction – About Cancer

Cancer =

General term for a malignant neof ormation (tumor)

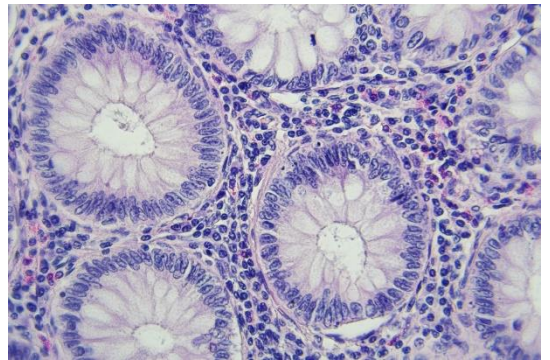


Underlying cause =

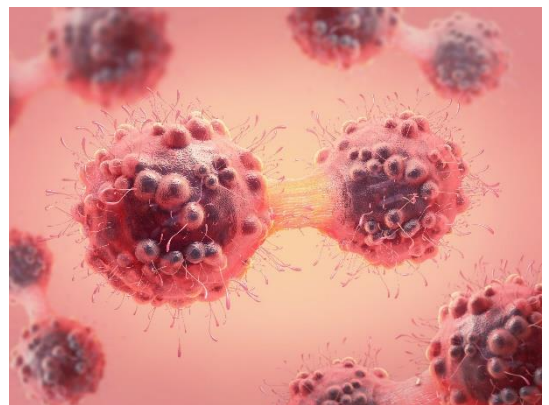
Uncontrolled growth of somatic cells

Tumor =

any form of swelling („lump“) of body-tissue



Pict. 2: Colon Cancer under the microscope



Pict. 3: Cancer Cell in cell division (mitosis)

Introduction – About Cancer

Terms and definitions

– **Carcinomas**

... are malignant tumors, which derive from epithelia. With about 90% contribution to all cancer diseases, they are the most common form.

– **Sarcoma**

... derive from connective and supporting tissue. Develop in the connective or supportive tissue and affect fatty tissue, muscles, tendons and bones.

– **Leukemia**

... begin in the blood-forming tissue of the bone marrow and do not form solid tumors.

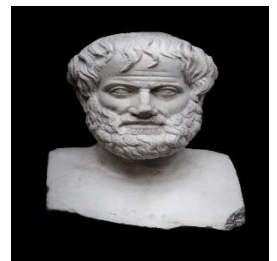
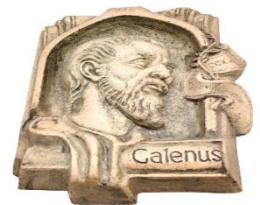
– **Other**

Lymphoma, Multiple Myeloma, Melanoma, Neuroendocrine Tumors

Introduction – About Cancer

Origin of the name „Cancer“

- According to Galenus the name „cancer“ is a reference to the veins of a superficial tumor, that reminded him of the legs of a cancer/crab
- Hippocrates has probably been the first to use the name „cancer“, when he discovered similarities between breast-ulceration and a crab’s legs. In addition the zodiac sign „cancer“ was attributed to the chest-/breast-area
- Aristoteles described cancer as superficially detectable, other tissue infiltrating lump (like skin-cancer and breast cancer)



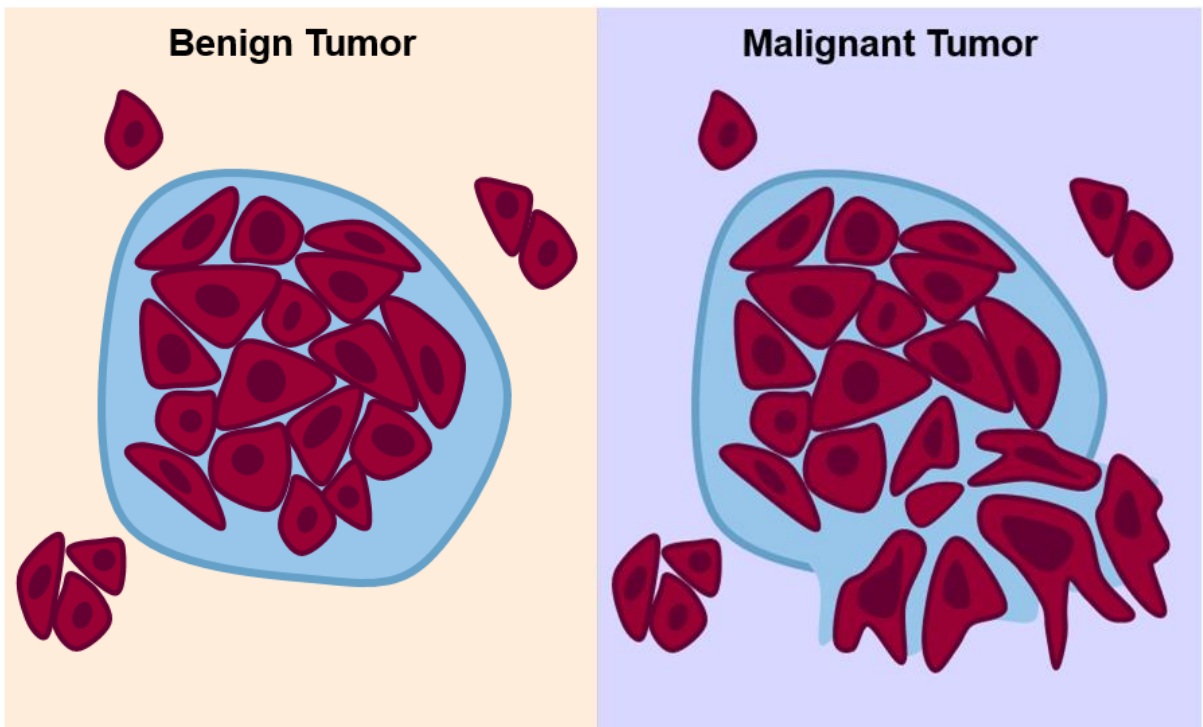
Introduction – About Cancer

Terms and definitions

The term 'cancer' is given to a category of related diseases occurring when the orderly process of cell growth is defective. Thus, endogenous cells uncontrollably divide and may form cell lumps (tumors) which in case of a malignant tumor can invade nearby tissues.

Depending on the affected organ, the type of tumor and its characteristics, different categories can be classified. A distinction is made between benign and malignant types of tumors. Cancerous tumors are malignant, which means that they aggressively grow, have the ability to spread into nearby tissues thereby destructing other organs and build metastasis. Further, malignant tumors are classified according to the tissues from which they originated.

Introduction – About Cancer



- Slow growth
 - Surrounded by outer surface
 - Displacing growth
 - Usually keep their cellular function
 - Only local impact on the body, usually small impact on whole organism
 - Lack the ability to metastasize
- Fast growth
 - Often invade basal membrane that surrounds nearby healthy tissue
 - Invasive and aggressive growth
 - Major impact on whole organism
 - Ability to metastasize

Introduction – About Cancer

Differentiation between benign and malignant tumors

| Base of comparison | Benign Tumor | Malignant Tumor |
|---------------------------|--|---|
| Meaning | The over growth of the cell, forming a lump (compact mass) at the site of origin but do not metastasize. | The abnormal, uncontrollable growth of the cell, which can metastasize to other parts of the body through the blood stream or lymphatic system. |
| Rate of growth | Slow-growing | Fast-growing cells, rapid cell division |
| Invasion activity | Benign tumors do not invade the surrounding tissue. | A malignant tumor has the capability to invade the surrounding tissue. |
| Ability to spread | Benign tumors do not spread to a different site. They only grow at the place, where growth started. | A malignant tumor has the capability to spread to a secondary or distant site, using blood or lymphatic system as their medium. |
| Appearance of cell | In a benign tumor cells often appear abnormal in comparison to normal cell growth and are readily detectable by the pathologist. | Malignant tumor cells appear to be abnormal, irregular in their shape, enlarged in size, dark colored, abnormal in growth of nuclei. DNA and chromosomes can be detected as abnormal under the microscope by the pathologist. |
| Treatment | A benign tumor can normally be treated by surgery, medication, or sometimes by radiation therapy. | In the case of a malignant tumor, chemotherapy, radiation therapy, or immunotherapy-medications are given to eradicate the cancerous cells. |

Introduction – About Cancer

Differentiation of malignant tumors

-Carcinoma

A cancer, that derives in the lining layer (epithelial cells) of organs.
About 90% of all cancers-forms are carcinomas.

-Sarcoma (greek: σάρκα, sarka = meat)

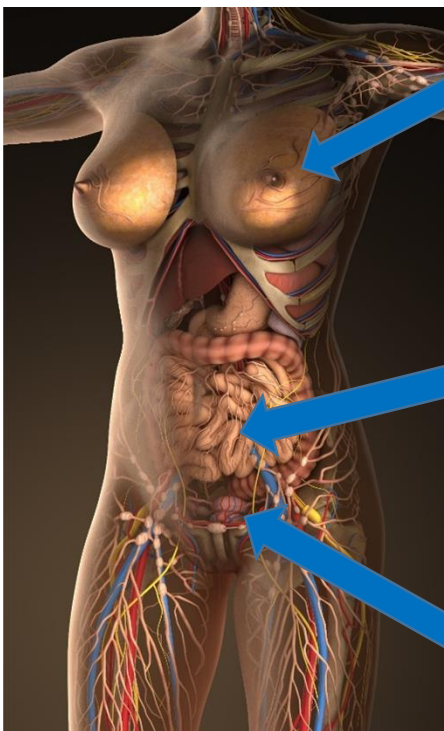
A cancer that starts in connective tissue, such as cartilage, fat, muscle, or bone.

E.g.:

- Rhabdomyosarcoma: Cancer of skeletal musculature
- Angiosarcoma: Cancer of the Blood vessels
- Leiomyosarcoma: Cancer of the smooth musculature

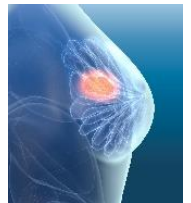
Introduction – About Cancer

Differentiation of malignant tumors

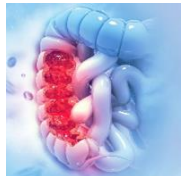


Pict. 4: Human female Body

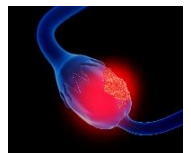
Mamma-carcinoma



Colon-carcinoma



Endometrium-carcinoma



Pict. 5: Carcinomas

Introduction – About Cancer

Neuroendocrine Tumors

...are neoplasms that derive from cells of the endocrine (hormonal) and nervous systems. Many are benign, while some are malignant. They most commonly occur in the intestines, where they are often called carcinoid tumors, but they are also found in the pancreas, lung and other parts of the body.

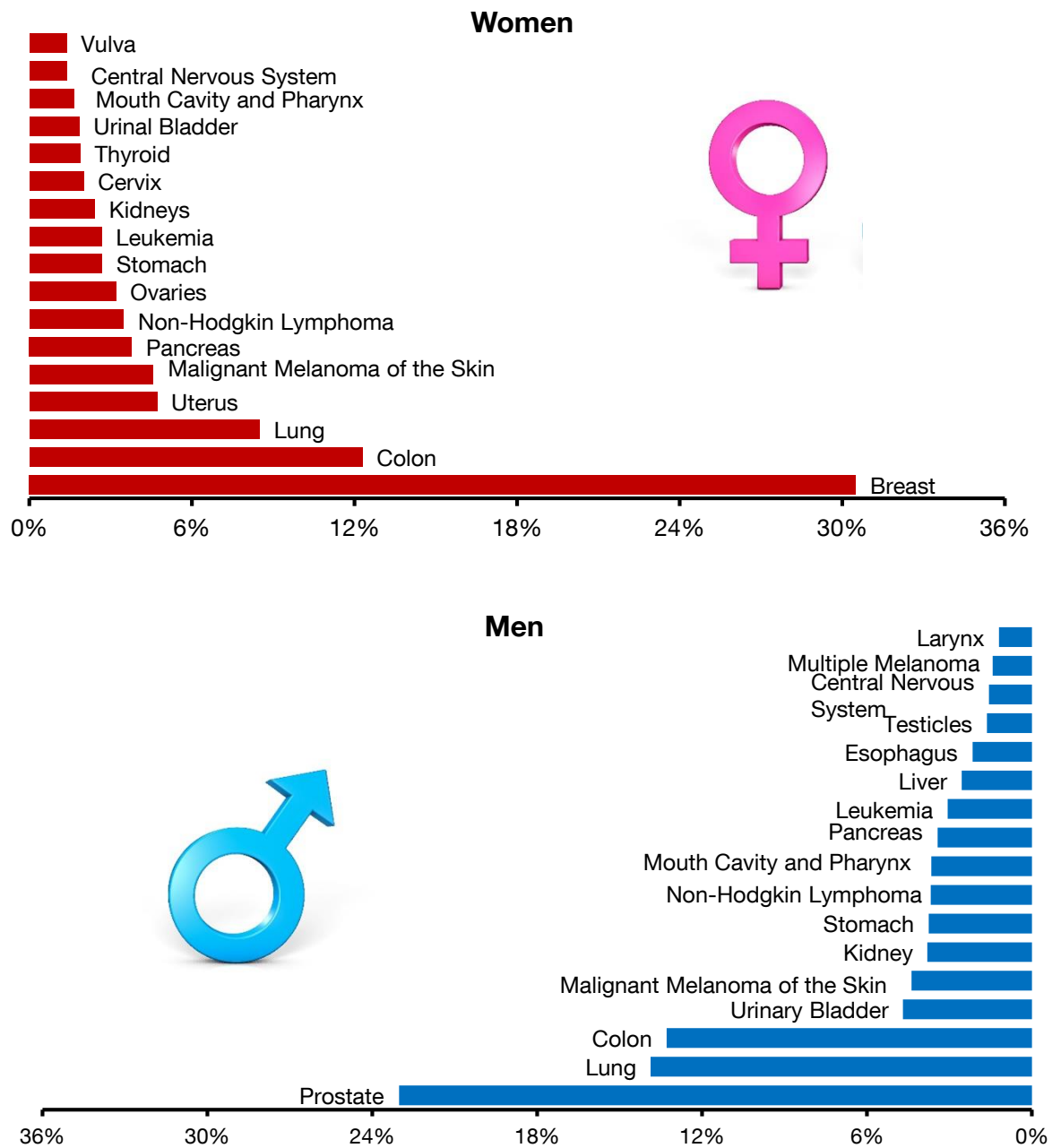
- Pheochromozytoma
- Insulinoma
- Hemato-oncological tumors
- Dysontogenetic tumors
- Mixed tumors

Introduction - Statistics

Definitions of Epidemiology

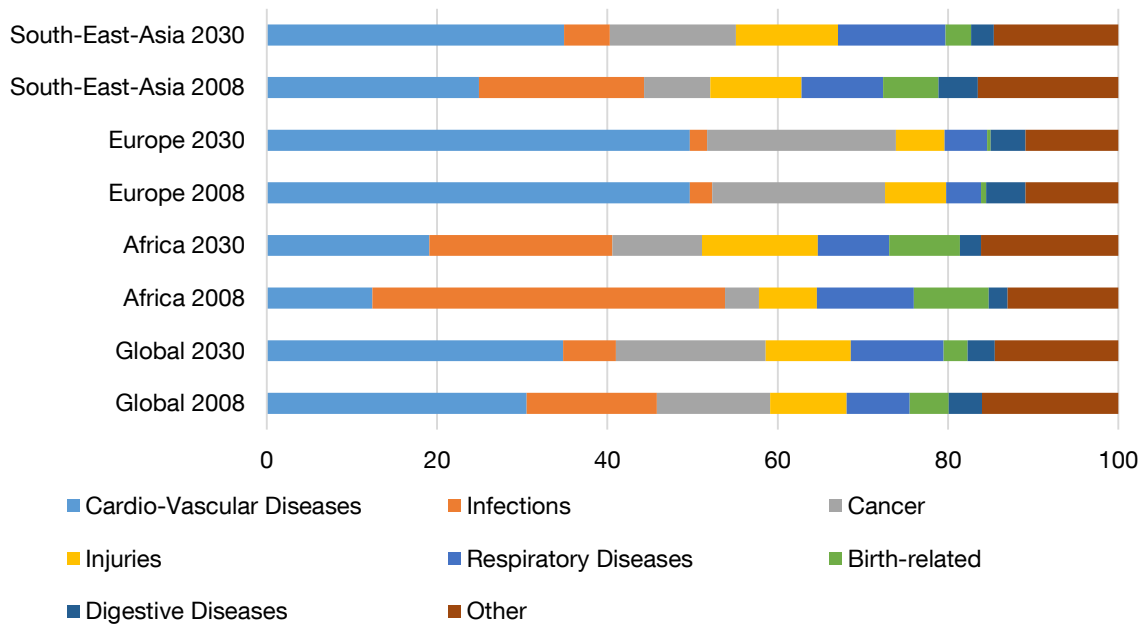
- Case of death: decease of a person
- Cause of death: direct cause for the occurred case of death
- Mortality: number of cases of death in a defined period of time
- Mortality rate: ratio between the number of cases of death in a defined period of time and the total number of a specific demographic group
- Morbidity rate: ratio of the occurrence of a certain disease and the total number of a specific demographic group
- Incidence: Number of new cases of a disease in a specific demographic group
- Relative 5-year survival rate: percentage of patients of a certain disease, who are alive five years after the point of diagnosis divided by the percentage of survivors in the corresponding population

Statistics - Incidence



Pict. 6: Percentage of the most frequent tumor localizations of all new cancer diseases in Germany (2014)

Prognosis death cases world wide 2030

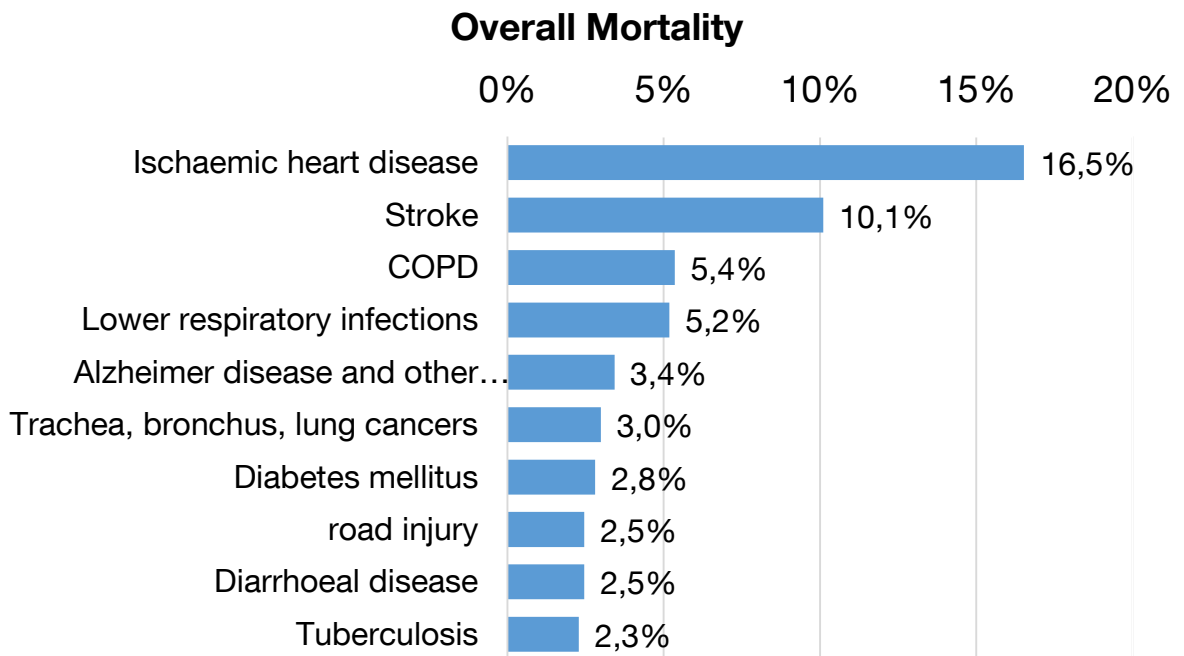


Pict. 7: Distribution of Cases of Death until 2030; generated based on data from Statista; WHO; HWWI

Take home message:

- The cases of death globally differ due to medical and socio-economic differences between different regions and countries.
- For 2030 an increase in the number of cancer deaths are predicted due to shifts in the socio-economic systems.
- In addition to that, demographic alterations lead to changes: people get older and are therefore more likely to get cancer.

The 10 most common causes of death world wide



Pict. 8: generated based on data from Global Health Estimates: Deaths by Cause, Age, Sex, by Country and by Region, 2000-2016 and Geneva, World Health Organization; 2018

Take home message:

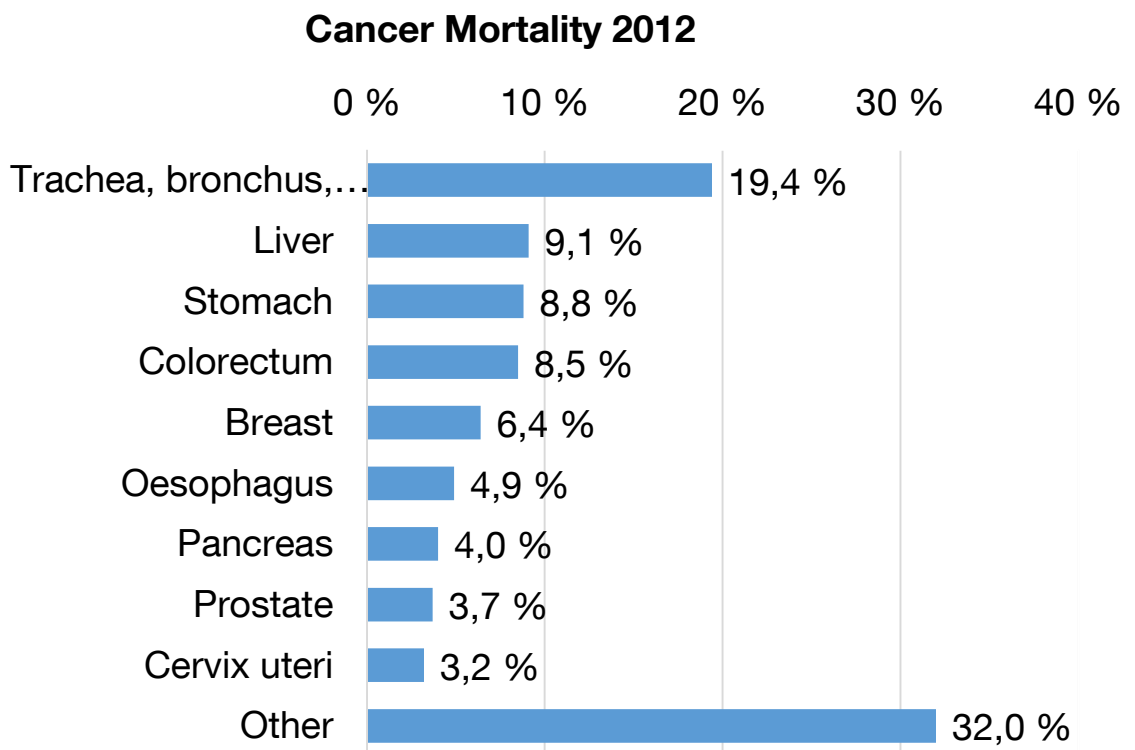
- Heart diseases are the number 1 reason for death worldwide
- Stroke has the second rank. Its risk factors include hypertension, smoking, diabetes mellitus, heart diseases, coagulopathy, obesity, dyslipidemia, alcohol abuse
- Trachea, bronchus and lung cancer, with smoking as its main risk factor, is on the 6th place and the deadliest cancer type by far ☹
this may differ from country to country

Statistics

Numbers worldwide

- 2012 8,2 million people died from cancer, according to estimations of the IARC
- Until 2030 this number is estimated to rise up to 13 million
- In 2030 5,5 million women worldwide will die every year
 - ☐ this is a dramatic increase of almost 60% in comparison to 2012
- 1,6 million people died from lung cancer in 2012
- With 0,8 million cases of death (9,1%) liver cancer is ranked as the second most deadly form of cancer followed by stomach cancer (0,7 million; 8,8%)
- The steep increase of cancer diseases is in parts caused by the predicted growth of the population and the increasing life span. Furthermore people in economical growing countries often adapt detrimental life-style habits of richer countries, such as unfavorable diets.

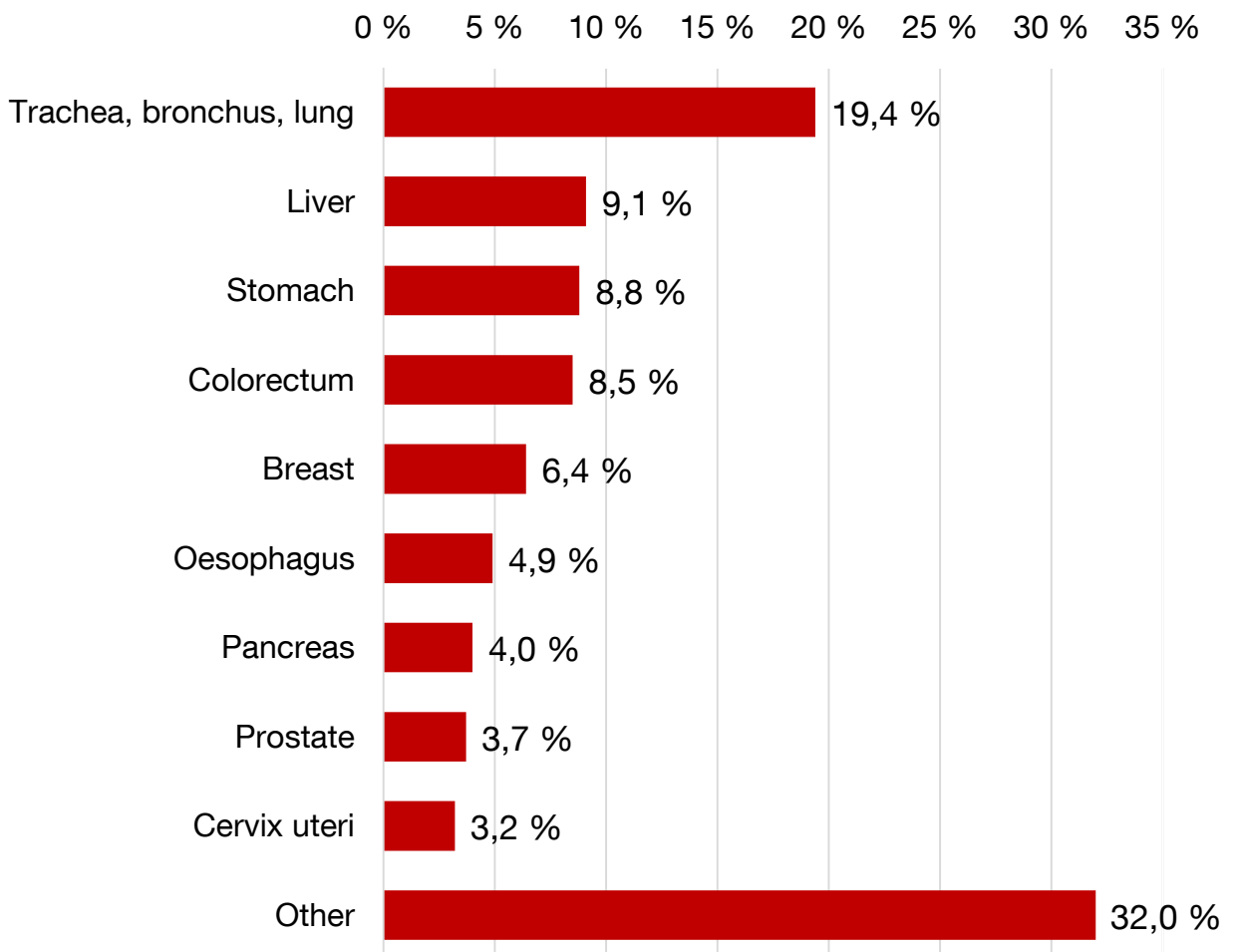
Statistics



Pict. 9: generated based on data from McGuire, S. 2016 and World cancer report 2014. Geneva, Switzerland: World Health Organization and International agency for research on cancer, WHO Press 2015

Statistics

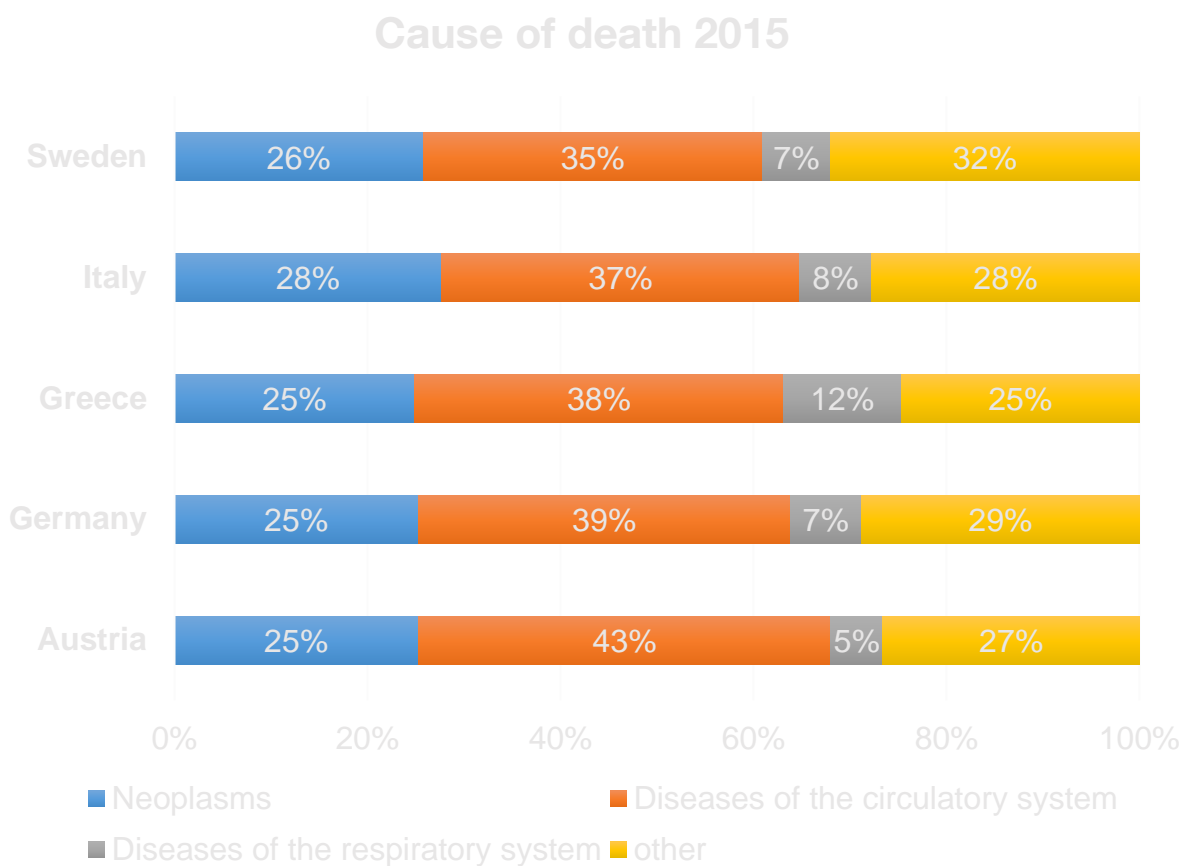
Most frequent cancer deaths worldwide – 2012



Pict. 10: generated based on data from McGuire, S. 2016 and World cancer report 2014. Geneva, Switzerland: World Health Organization and International agency for research on cancer, WHO Press 2015

Statistics

Cancer is responsible for about one quarter of annual deaths in our European countries



Pict. 11: Overview on causes of death in partner countries; based on data from WHO Cancer Report

Statistics

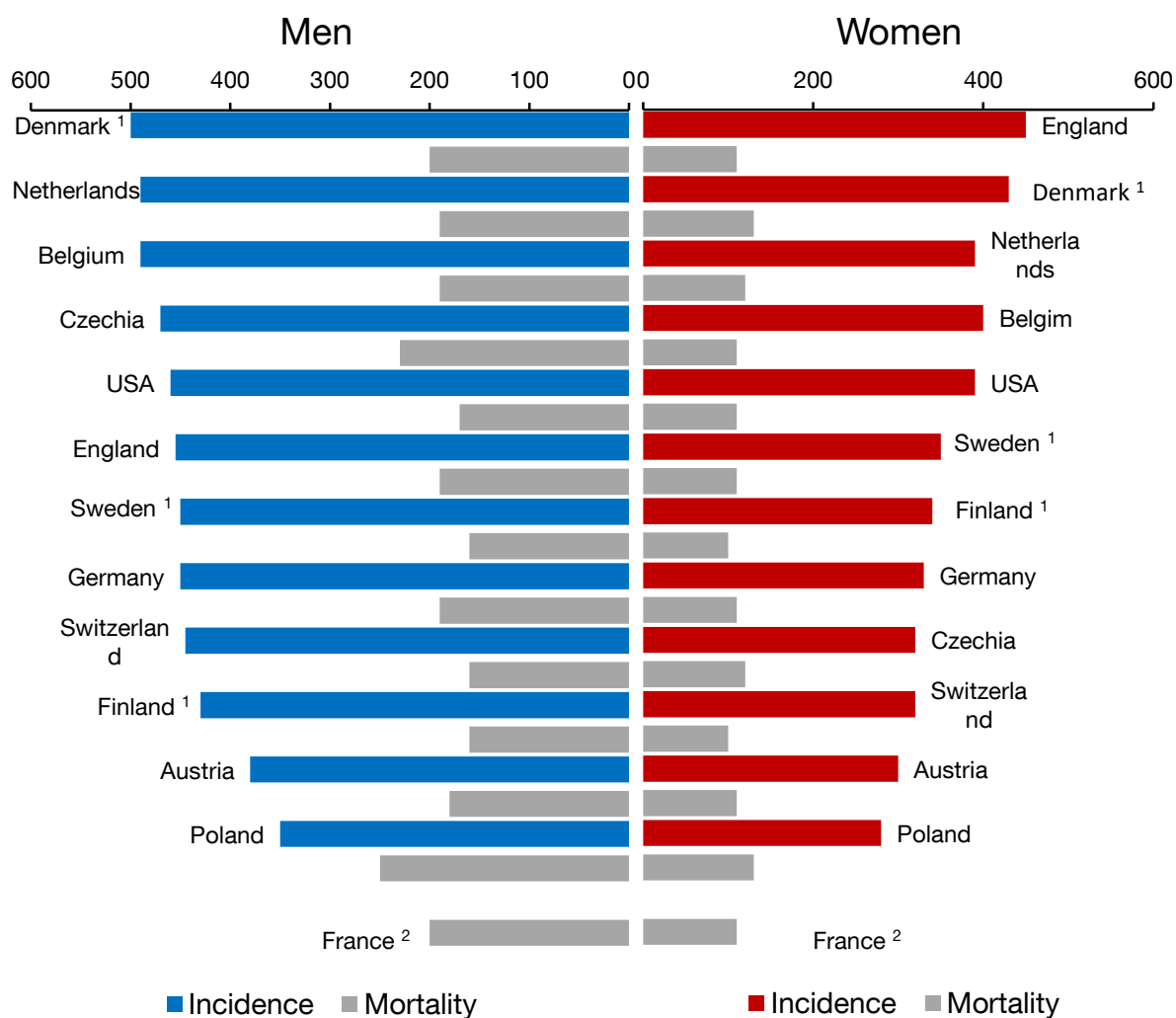
Percentage of all death cases in participating countries – 2015

| | Austria | Germany | Greece | Italy | Sweden |
|---|----------|-----------|-----------|-----------|----------|
| Neoplasm of trachea, bronchus and lung, both sexes | 19,1 % | 20,0 % | 24,1 % | 19,9 % | 16,2 % |
| Neoplasm of colon, rectosigmoid junction, rectum, anus and anal canal, both sexes | 10,0 % | 11,2 % | 9,4 % | 11,1 % | 12,4 % |
| Malignant neoplasm of pancreas, both sexes | 8,2 % | 7,6 % | 6,3 % | 6,8 % | 8,1 % |
| Malignant neoplasm of breast, female | 7,7 % | 8,0 % | 7,1 % | 7,2 % | 6,3 % |
| Malignant neoplasm of prostate, male | 5,5 % | 6,1 % | 5,9 % | 4,2 % | 10,5 % |
| Malignant neoplasm of lymphomas and multiple myeloma, both sexes | 4,8 % | 4,9 % | 3,8 % | 5,2 % | 5,3 % |
| Malignant neoplasm of liver and intrahepatic bile ducts, both sexes | 4,5 % | 3,5 % | 5,2 % | 5,7 % | 3,1 % |
| Malignant neoplasm of stomach, both sexes | 4,1 % | 4,1 % | 4,6 % | 5,5 % | 2,5 % |
| Leukaemia, both sexes | 3,4 % | 3,5 % | 3,8 % | 3,5 % | 3,3 % |
| Benign neoplasms, both sexes | 3,1 % | 3,3 % | 1,9 % | 5,0 % | 4,6 % |
| Malignant neoplasm of bladder, both sexes | 2,6 % | 2,6 % | 4,4 % | 3,3 % | 3,0 % |
| Malignant neoplasm of lip, oral cavity and pharynx, both sexes | 2,6 % | 2,4 % | 1,2 % | 1,7 % | 1,5 % |
| Melanoma and other skin cancers, both sexes | 2,5 % | 1,7 % | 1,4 % | 1,7 % | 2,6 % |
| Malignant neoplasm of ovary, female | 2,2 % | 2,4 % | 1,9 % | 1,9 % | 2,3 % |
| Malignant neoplasm of oesophagus, both sexes | 1,6 % | 2,4 % | 0,6 % | 1,1 % | 2,0 % |
| Malignant neoplasm of corpus uteri, female | 1,3 % | 1,1 % | 1,2 % | 1,5 % | 1,6 % |
| Malignant neoplasm of cervix uteri, female | 0,7 % | 0,7 % | 0,5 % | 0,3 % | 0,7 % |
| Total of malignant neoplams, both sexes | 100,0 % | 100,0 % | 100,0 % | 100,0 % | 100,0 % |
| Population number | 8,58 Mio | 82,18 Mio | 10,86 Mio | 60,80 Mio | 9,85 Mio |

Pict. 12: generated based on data from Source WHO Mortality Database
<http://apps.who.int/healthinfo/statistics/mortality/whodpms/>

Statistics

ICD-10 C00-C97 without C44, 2013 – 2014 (per 100.000 Inhabitants)



Pict. 13: generated based on data from Age Standardized Rate of Incidence and Mortality - International comparison. ¹with D09.0–1, D30.1–9, D35.2–4, D41.1–9, D32–D33, D42–D43, D44.3–5, D46–D47 but without C46.0; ² not available

Statistics

New cases of cancer in Germany in 2014, differences between genders

| Male | | | Female | | |
|------------------|-----------|--------|---------------------|-----------|-------|
| Cancer Type | Incidence | | Cancer Type | Incidence | |
| Digestive System | 66809 | 26,8 % | Breast | 69220 | 30,5% |
| Genitals | 62394 | 25,0 % | Intestines | 51344 | 22,6% |
| Prostate | 57368 | 23,0 % | Genitals | 26276 | 11,6% |
| Lung | 34559 | 13,9 % | Lung | 19276 | 8,5% |
| Urinary tract | 22893 | 9,2% | Colon | 18711 | 8,2% |
| Colon | 20173 | 8,1% | Urinary tract | 10695 | 4,7% |
| Bladder | 11678 | 4,7% | Cervix uteri | 10679 | 4,7% |
| Rectum | 11414 | 4,6% | Maligna melanoma | 10313 | 4,5% |
| Malign melanoma | 10917 | 4,4% | Pancreas | 8576 | 3,8% |
| Kidney | 9480 | 3,8% | Non-Hodgin lymphoma | 7875 | 3,5% |
| total | 249215 | 100% | total | 227001 | 100% |



Breast cancer is with 30% the most frequent form of cancer in women

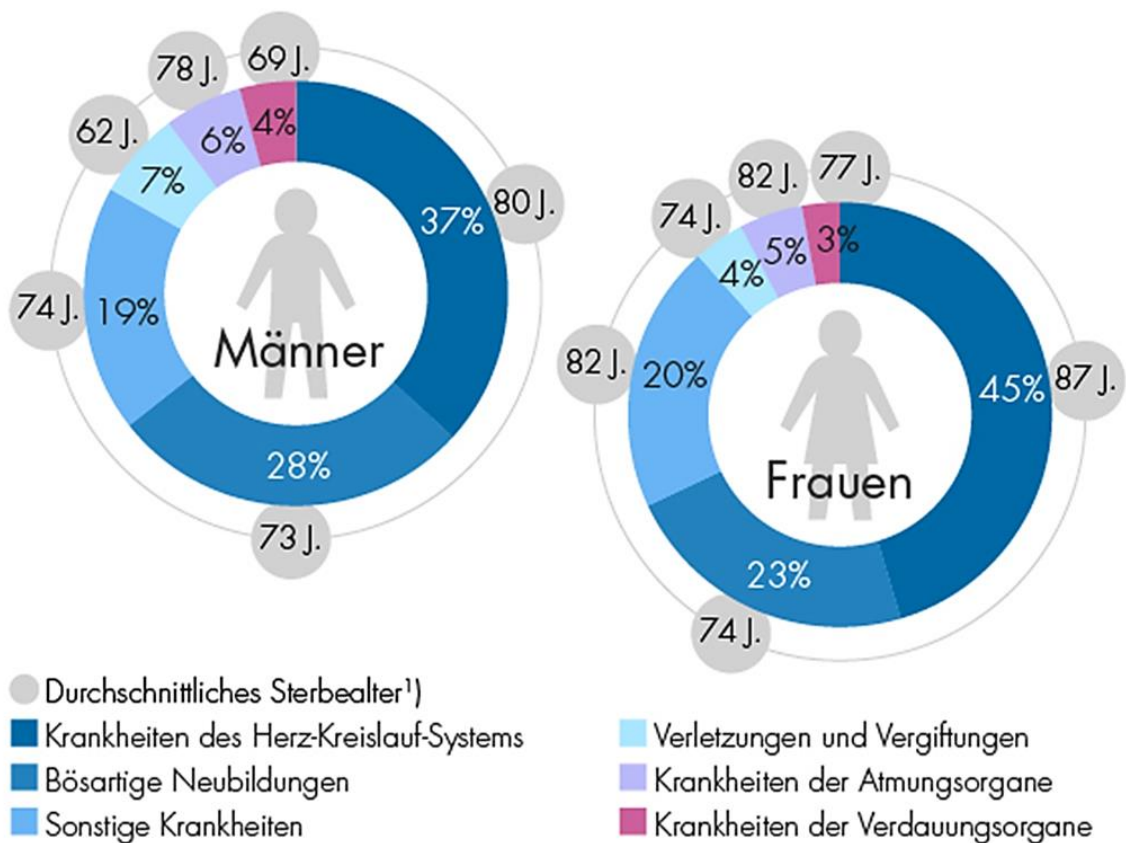
Pict. 14: generetad based on data from Robert Koch-Institut, Zentrum für Krebsregisterdaten (2017). Krebs in Deutschland für 2013/2014.

Example: Austria

- In 2014 Austria had a population of 8,54 million people
- The amount of 0-14 year olds was at 14%. Approximately 24% were 60 or older.
- The amount of 0-14 year olds is continuously decreasing and according to predictions, is going to stagnate until the year 2050. On the other hand, the amount of 60+-year olds increased and is going to grow.
- The demographic growth is almost exclusively caused by immigration – especially since 2009.
- The biggest demographic growth is seen in Vienna.

Example: Austria

Todesursachen 2016



Pict. 15:

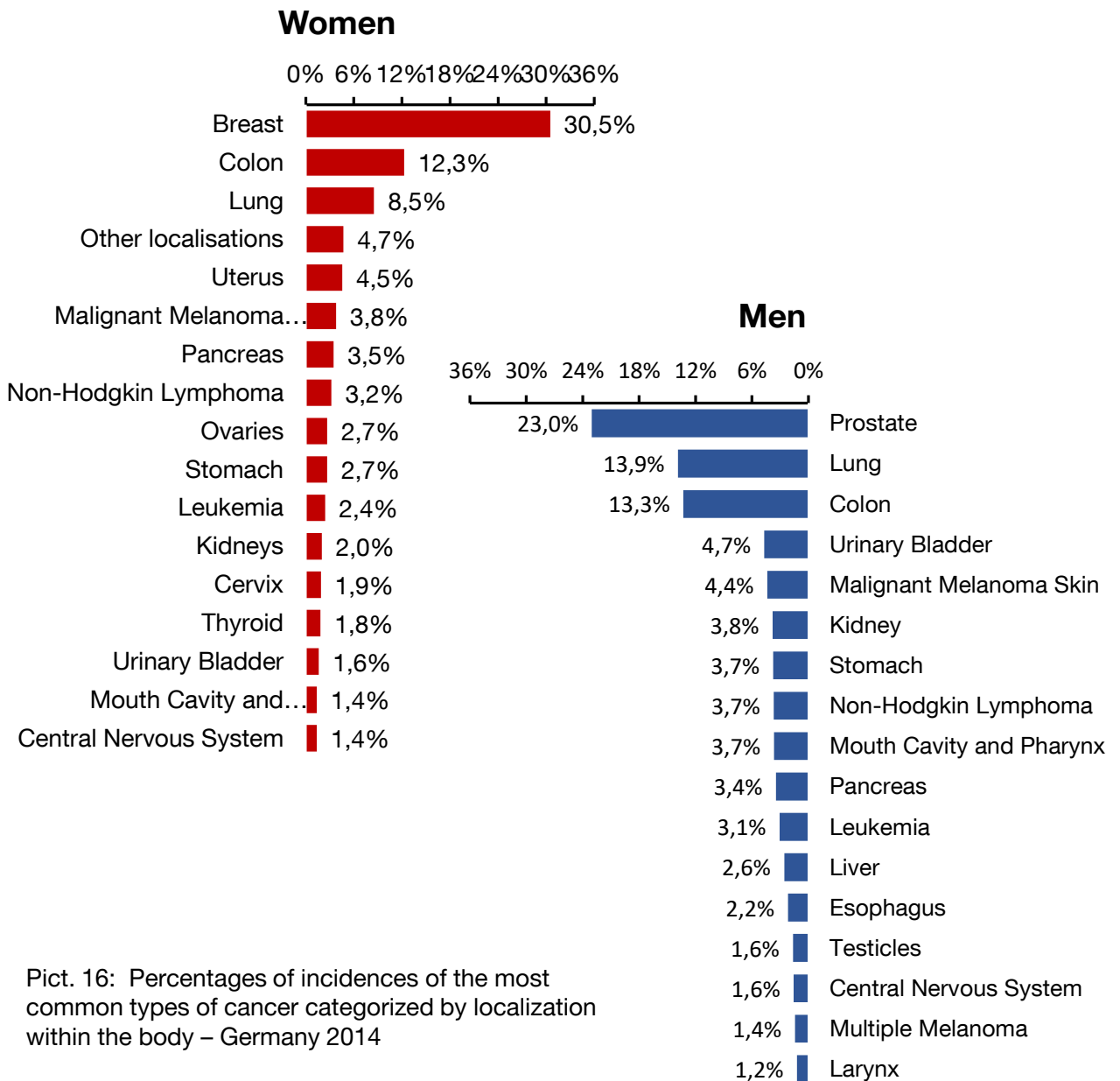
<http://www.statistik.at/wcm/idc/groups/mi/documents/webobj/mdaw/mte1/~edisp/115155.jpg>

Example: Austria

Life expectancy and subjective evaluation of health

- In 2014 the life expectancy for newborn girls is indicated as 83,7 years, for boys 78,9 years. Within the last 10 years it has been increasing. The difference between men and women decreased.
- Women can expect to live 67 years with good or very good health – men 66 years (*health life expectancy*)
- The health life expectancy is increasing faster than the life expectancy. Hence, the periods of life lived in bad health shortens.
- Women live more years in bad health or with disabilities than men.
- 79% of the population aged 15years and older estimates their own health as good or very good. Especially in the older population the subjective health status has been markedly improved since 2006/2007.

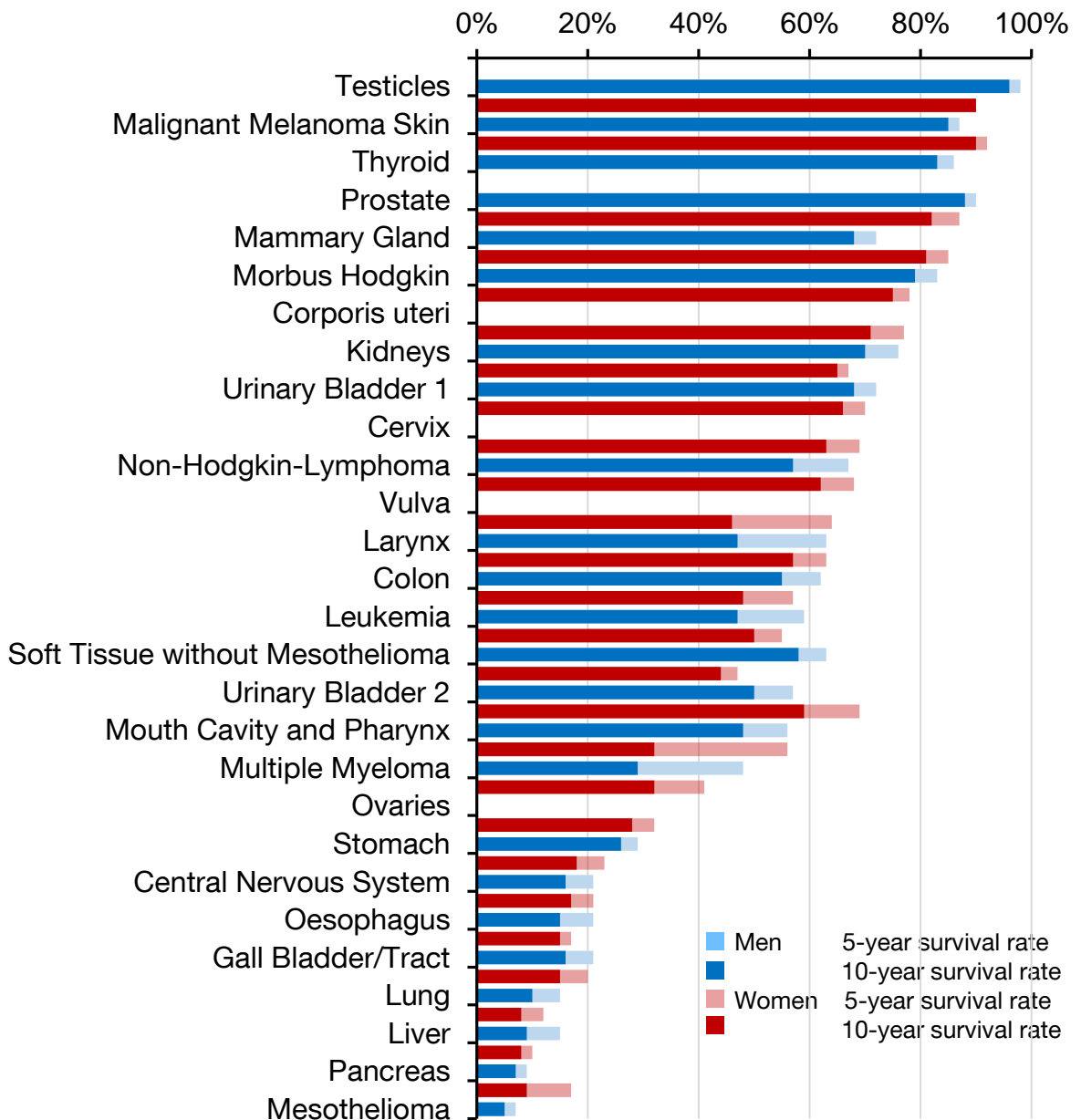
Incidences



Pict. 16: Percentages of incidences of the most common types of cancer categorized by localization within the body – Germany 2014

Take home message: In most of the OaC-training groups colon-, breast- and prostate cancer are going to be the most common type of cancer

Comparison of the relative 5-/10 year survivor rate



Pict. 17: Comparison of the relative 5-/10 year survivor rate, categorized by cancer-type and gender - Germany 2013 – 2014

Take home message: Not every cancer has the same survival rate [?] after 5 years you are not cured, but the survival rates are increased

Cancer

Incidence is increasing, mortality is decreasing

- Improved medical care, improved therapy-conditions
- The aftercare is of increasing interest, as cancer-therapy has a variety of side effects
- Chemotherapy targets cells, which divide frequently, including healthy ones: hair, mucosa, skin, haemopoetic stem cells
- Side effects can be nausea, vomiting, susceptibility to infections, anemia, fatigue and weight loss
- Restrictions of physique and quality of life, whereas one affects the other
- Side effects are often persistent for several years i.e. fatigue, anxieties, depressions
- Surgery lead to restricted mobility, lymphedemas
- Hormone therapy means premature menopause, infertility
 - ❓ change in sexuality, childlessness

Take home message: Point out consequences, refer to possibilities of outdoor sports and physical activity, especially in relation to the side effects

Cancer development

What is etiology?

Etiology aims at identifying factors that contribute to a certain disease in the sense that the factor or the interaction of certain factors are the direct **causes** for the development of a disease. Factors of interest often are demographic factors (region, gender, age), exposure to pollutants and life-style factors

What is pathogenesis?

Pathogenesis on the other hand investigates on the **biological mechanisms** that occur in the onset and the process of a disease.

Take home message: Taking the causes/etiology for a disease into account is important in preventing a disease before it even occurs (primary prevention). The biological mechanisms/pathogenesis of a disease on the other hand are important in the process of treating a disease (secondary prevention).

The primary prevention is only possible if the causes are well known.

❓ How well known are the causes of cancer? Can the “why me?”-question be answered for cancer patients?

Cancer development

What causes cancer?

Cancer is a genetic disease caused by changes of the genetic material (mutations) due to errors that occur during cell division. However, there is not one single cause of cancer but instead it is the interaction of many factors that can contribute to the development of cancer. The factors involved may be of genetic, environmental or viral nature. The following risk factors have been proposed as contributing factors:



- **Biological / internal factors** (age, gender, inherited genetic defects...)
- **Environmental exposures** (e.g. UV-radiation, pesticides)
- **Occupational factors** (e.g. chemicals, radioactive materials)
- **Lifestyle-related factors** (e.g. smoking, high-fat diet, alcohol)

However, a risk factor is anything that may increase a person's chances of developing cancer but one cannot attribute the disease to a single cause.

Carcinogenesis

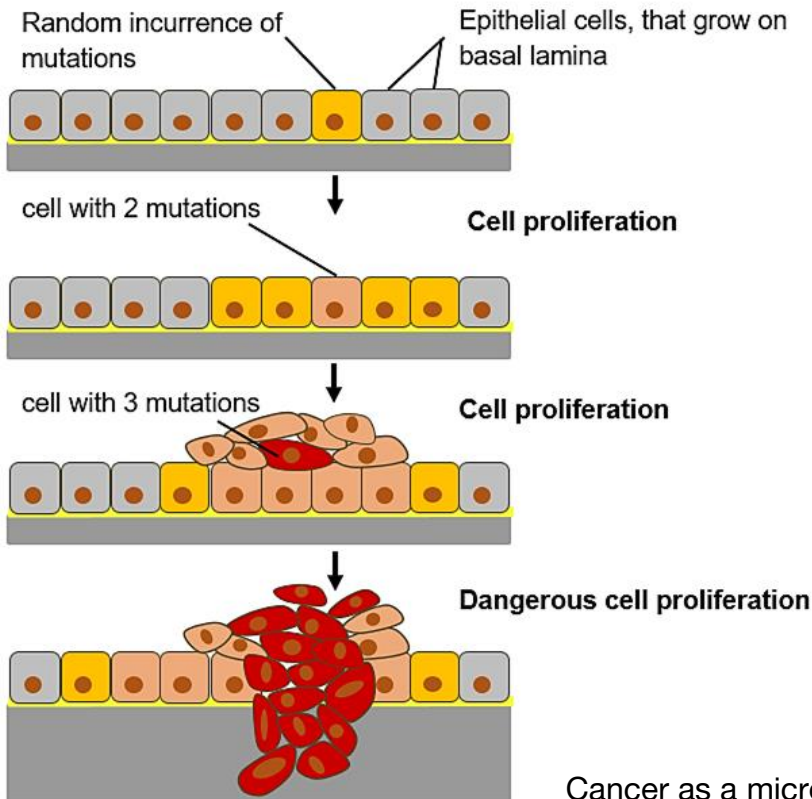
Cell division

The cell cycle, or cell-division cycle, is the series of events that take place in a cell leading to duplication of its DNA (DNA replication) and division of cytoplasm and organelles to produce two daughter cells.

The cell-division cycle is a vital process by which a single-celled fertilized egg develops into a mature organism, as well as the process by which hair, skin, blood cells, and some internal organs are renewed.

After cell division, each of the daughter cells begin the interphase of a new cycle. Although the various stages of interphase are not usually morphologically distinguishable, each phase of the cell cycle has a distinct set of specialized biochemical processes that prepare the cell for initiation of cell division.

Pathogenesis



Pict. 18:
Cancer as a micro-evolutionary process

„100 billion cells (maybe even more than 10 quadrillion cells) have to cooperate in a person’s life-span “

If each of those cells can become a cancer-cell, why does „only“ half of the population develop cancer?

Pathogenesis

In healthy cells, genes regulate growth, maturity and death of the cells. Genetic changes can occur on many levels. There could be a gain or loss of the entire chromosomes or a single point mutation affecting a single DNA nucleotide.

There are two broad categories of genes within the ontogenesis which are affected by these mutations:

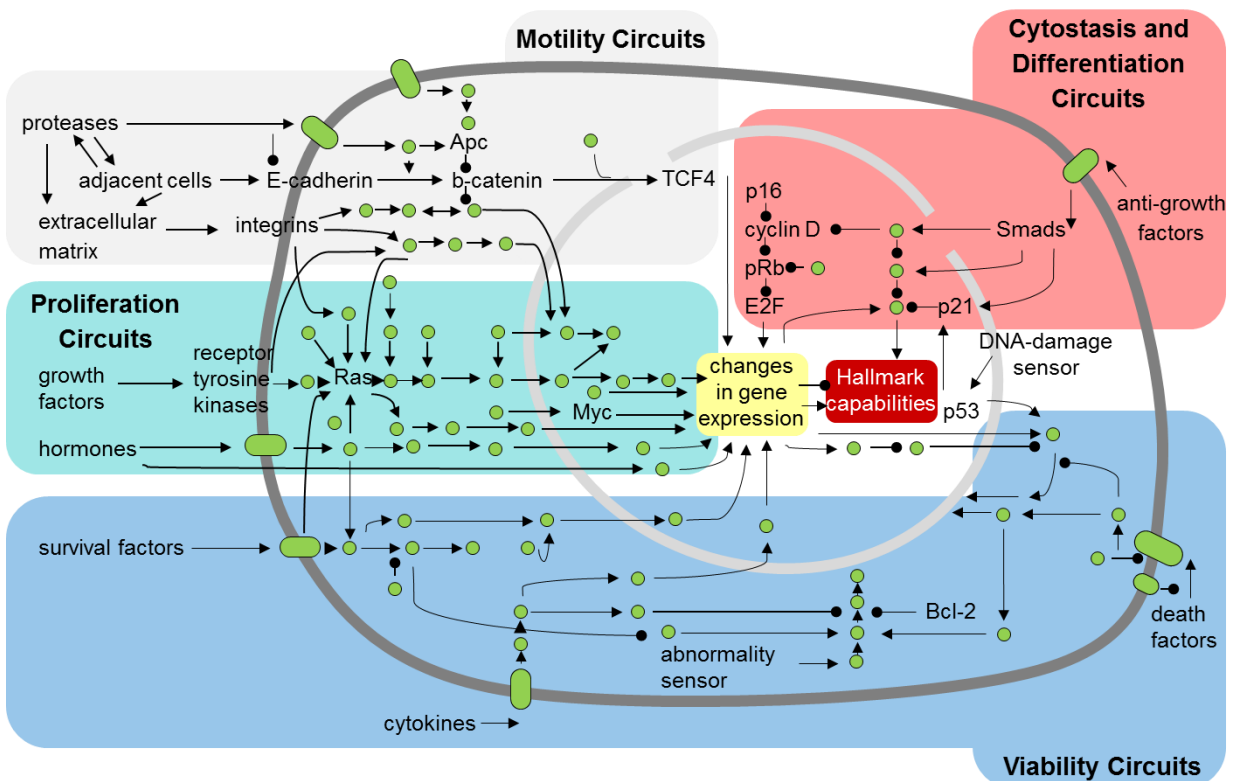
- Oncogenes

These are cancer causing genes. Mutations can either lead to the production of a pathologically large amount of normal genes or genes can be altered into abnormal genes by mutation. In both cases these genes lead to cancerous changes in the tissues.

- Tumor suppressor genes

These genes normally inhibit cell division and prevent survival of cells that have damaged DNA. In patients with cancer, these tumor suppressor genes are often disabled. This is caused by cancer-promoting genetic changes. Typically, changes in many genes are required to transform a normal cell into a cancer cell.

Cancer Hallmarks and Circuits



Pict. 20: Many different cancer-associated genes are involved in the cell division

Take home message:

- A lot of factors interact in the disease process of cancer on the cellular level. Cancer is therefore a random incidence.
- The question of “why” is therefore cumbersome: the better question is: “what can I now do to improve the situation?”
- Physical activity interacts with the regulatory cycle: regulation of the endocrine system, growths factors, cytokines, apoptosis

Cell physiology

Genomic amplification

Sometimes there may be genomic amplifications. In this case a cell gains many copies (often 20 or more) of a small chromosomal locus, usually containing one or more oncogenes and adjacent genetic material.

Point mutations

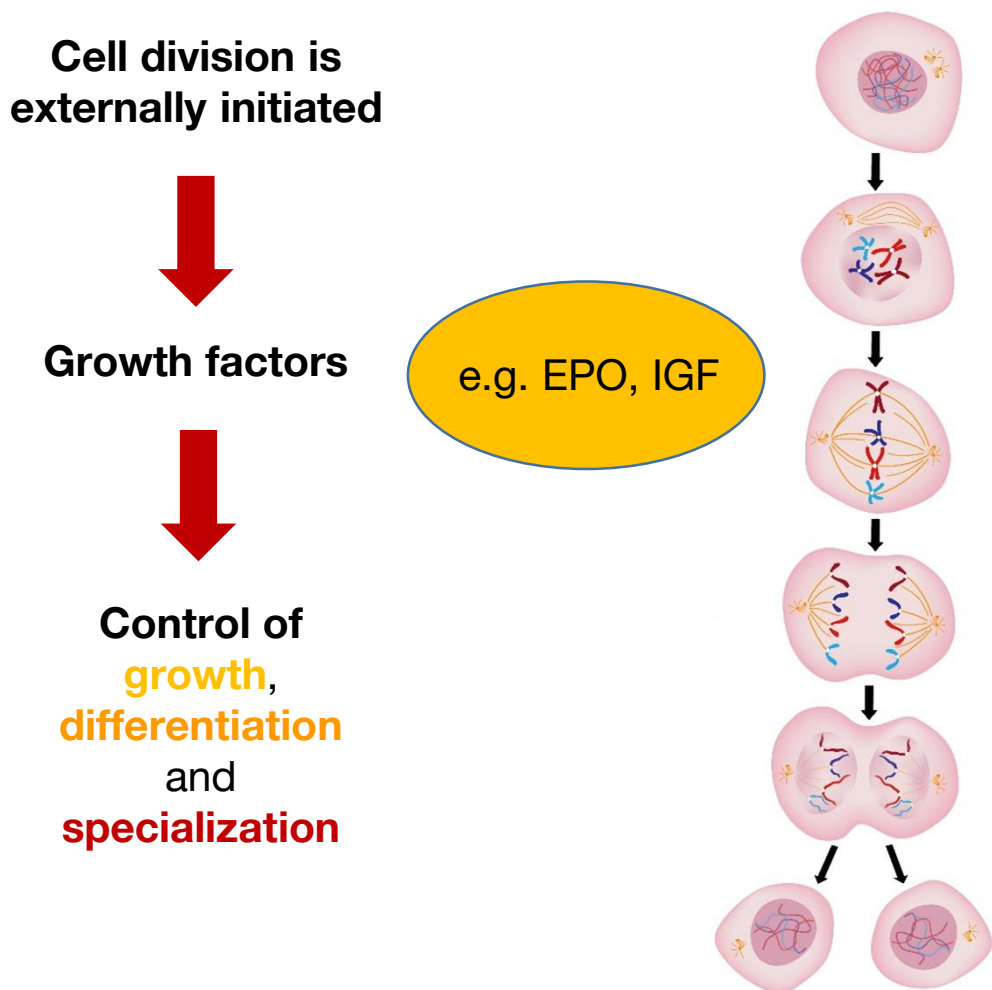
Point mutations occur at single nucleotide. There may be deletions or insertions especially at the promoter region of the gene. This changes the protein coded for by the particular gene. Disruption of a single gene may also result from integration of genomic material from a DNA virus or retrovirus. This may lead to the formation of oncogenes.

Translocation

Translocation is yet another process, in which two separate chromosomal regions become abnormally fused, which results in an unusual rearrangement of chromosomes, often at a characteristic location. A common example is the Philadelphia chromosome, or translocation of chromosomes 9 and 22, which occurs in chronic myelogenous leukemia, and results in the production of the *BCR-abl* fusion protein, an oncogenic tyrosine kinase.

Carcinogenesis

The cell division is being initiated from the outside by growth factors like IGF and EPO. Those growth factors are responsible for the control of **Growth**, **Differentiation** and **Specialisation**.



Pict. 21: Cell Physiology: Regulation of the cell division

Carcinogenesis

Take home message:

Controlling the cell division cycle is of particularly important for a complex organism. Otherwise it could lead to pathological growth. Once the growth regulation is out of control, tumors and cancer can develop.



Growth factors are also important for physical activity and training adaptations: EPO for the formation of blood, IGF as a stimulus for muscle growth. Those are being released during physical activity. physical activity does not only increase the production of growth factors but regulates them.

Cell physiology

Tumors

Tumor means swelling (lat.: tumor=swelling) but not all swellings are tumors in the modern sense of the term. Some forms of swellings, may be caused due to inflammation, infections, cysts or fluid filled lesions or due to benign growths. A cancerous tumor has the capacity to grow rapidly and to metastasize or spread to other tissues. Some tumors like leukemia grow as cell suspensions but most grow as solid masses of tissue.

Solid tumor parts

Solid tumors have two distinct parts. One of them is the parenchyma that contains cancer tissues and cells and the other is the stroma that the neoplastic cells induce and in which they are dispersed.

Tumors that originate from epithelial cells have a basal lamina that separates clumps of tumor cells from the stroma. However, the basal lamina is often incomplete, especially at points of tumor invasion. The stroma is juxtaposed between malignant cells and normal host tissue and is essential for tumor growth. The stroma contains nonmalignant supporting tissue and includes connective tissue, blood vessels, and, very often, inflammatory cells. All solid tumors require stroma if they grow beyond the minimal size of 1mm to 2 mm.

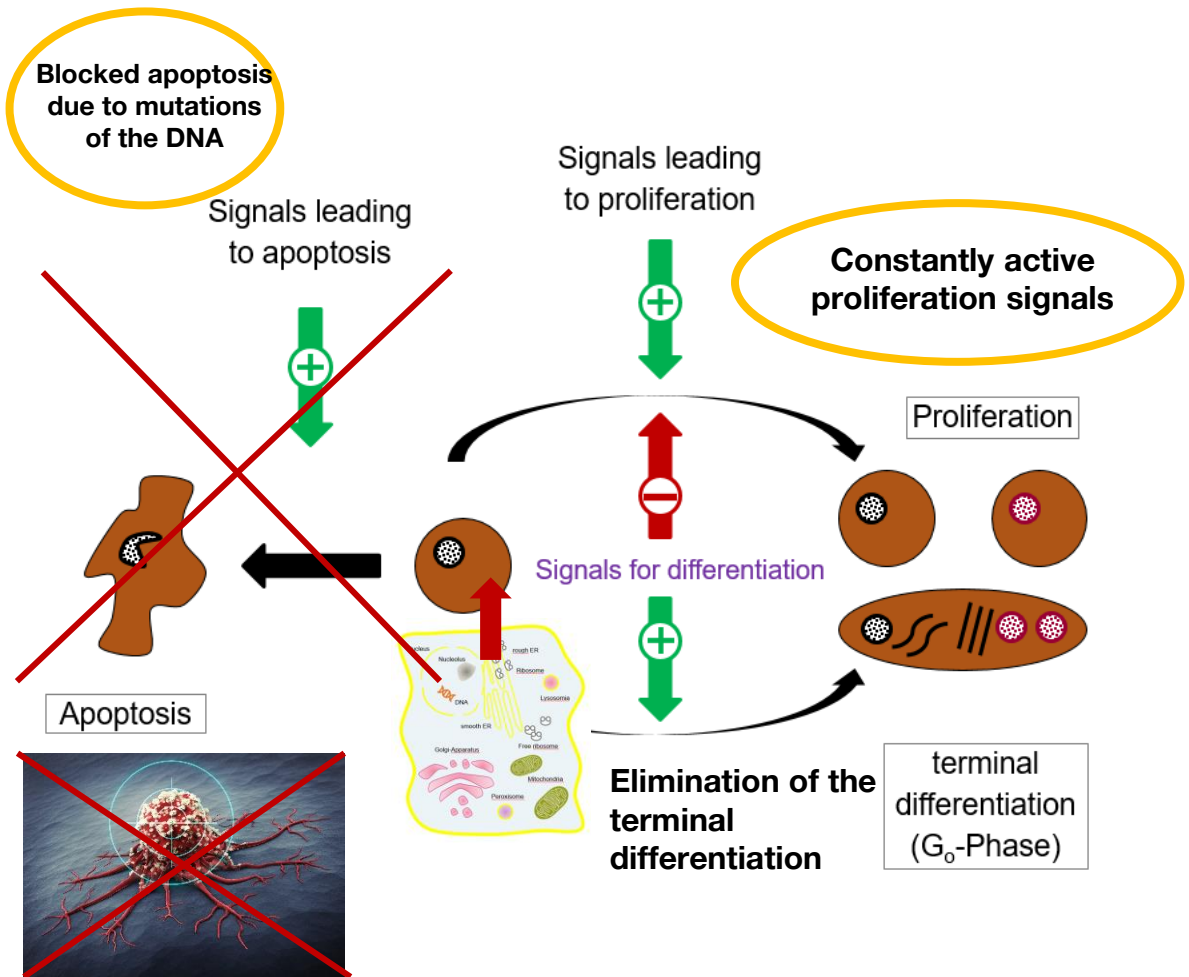
Cell physiology

Solid Tumors

In addition, tumors that are cancerous also have the ability to form new blood vessels. Blood vessels are only one component of tumor stroma. In fact, in many tumors, the greatest part of the stroma comprises interstitial connective tissue whereas blood vessels constitute for only a minor component of the stromal mass. The stroma also contains tissues and cells from blood including water and plasma proteins, together with various types and numbers of inflammatory cells. In addition there are proteoglycans and glycosaminoglycans, interstitial collagens (types I, III, and, to a lesser extent, type V), fibrin, fibronectin, fibroblasts, etc.

(Source: Hornberg J., Bruggemann F., Westerhoff H., Lankelma J., 2004)

Carcinogenesis



Pict. 22: Cell Physiology
 modified from Evan, G. I., & Vousden, K. H. 2001. Proliferation, cell cycle and apoptosis in cancer. Nature

The origin of cancer development takes place on a cellular level
 a) by uncontrolled cell proliferation and b) by changes in the DNA of cells, that occur due to errors during cell division. Apoptosis cannot be executed due to damages of the DNA.

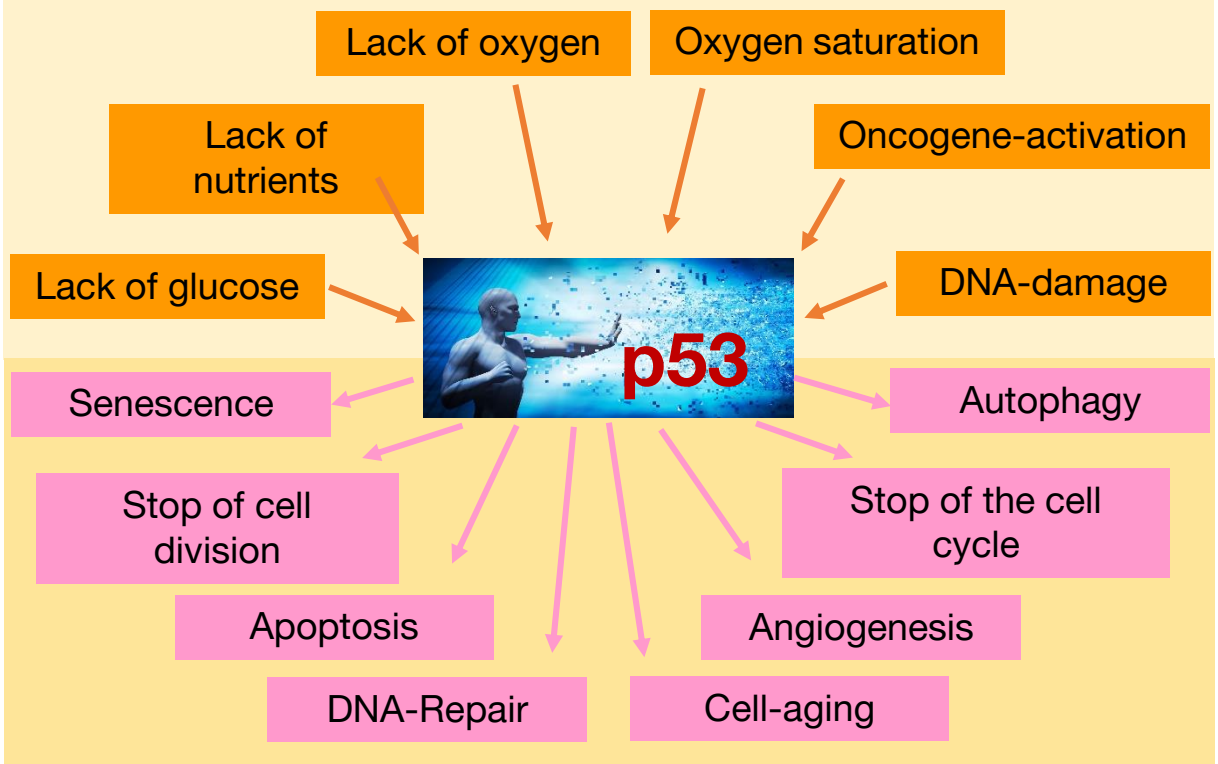
Pathophysiology

- Tumor cells develop due to changes of proteins, that have a defining role in cell proliferation and differentiation of cells.
- Proliferation genes and anti-proliferation genes:
Genes, that promote cellular growth and genes that inhibit cellular growth.
- Mutations of those genes are the underlying reason for tumor-diseases.
- Example: p53-protein (=tumor-suppressor gene)
“Guard” of the Genome, one of the most important control mechanisms for the integrity of the DNA. Mutations in this gene are found in 50% of all tumors.

Pathophysiology

Tumor suppressor gene p53 in 50% of all cancers mutation of this gene

Trigger



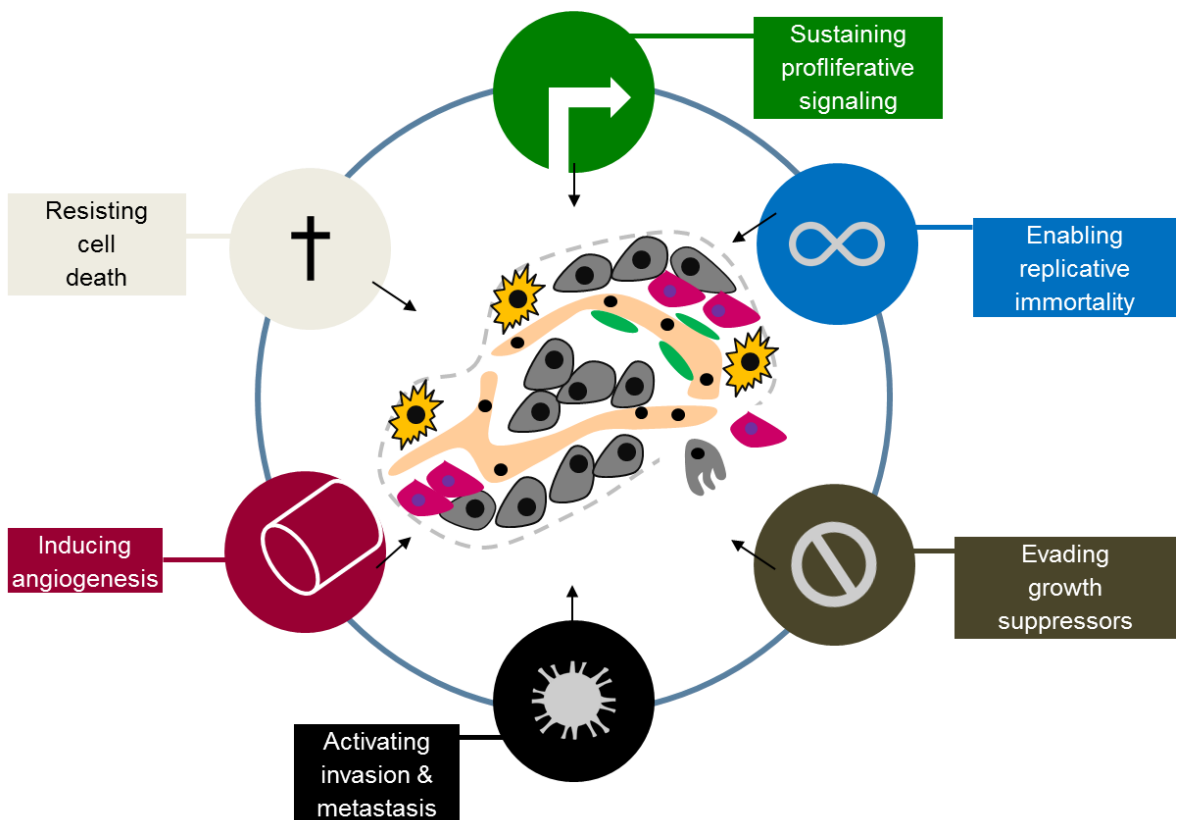
Pict. 23: p53

One of the most important genes within the occurrence of cancer

Hallmarks of Cancer

Sustaining Proliferative Signaling

The hallmarks of cancer originally comprise six different biological capabilities obtained during the multistep development of human tumors. These hallmarks comprise an organizing principle for rationalizing the complexities of neoplastic disease.



Pict. 24: Hallmarks of Cancer
generated based on data from Hanahan, D., & Weinberg, R. A. (2011). Hallmarks
of cancer: the next generation. *cell*, 144(5), 646-674

Hallmarks of Cancer

Multistep development of human tumors

Adding inflammatory micro-environment (which was originally not included), this sums up to 7 hallmarks of cancer:

- Tissue invasion & metastasis
- Inflammatory micro environment
- Insensitivity to growth inhibitors
- Self-sufficiency in growth signals
- Limitless replicative potential
- Sustained angiogenesis
- Evasion of apoptosis

Hallmarks of Cancer

Multistep development of human tumors

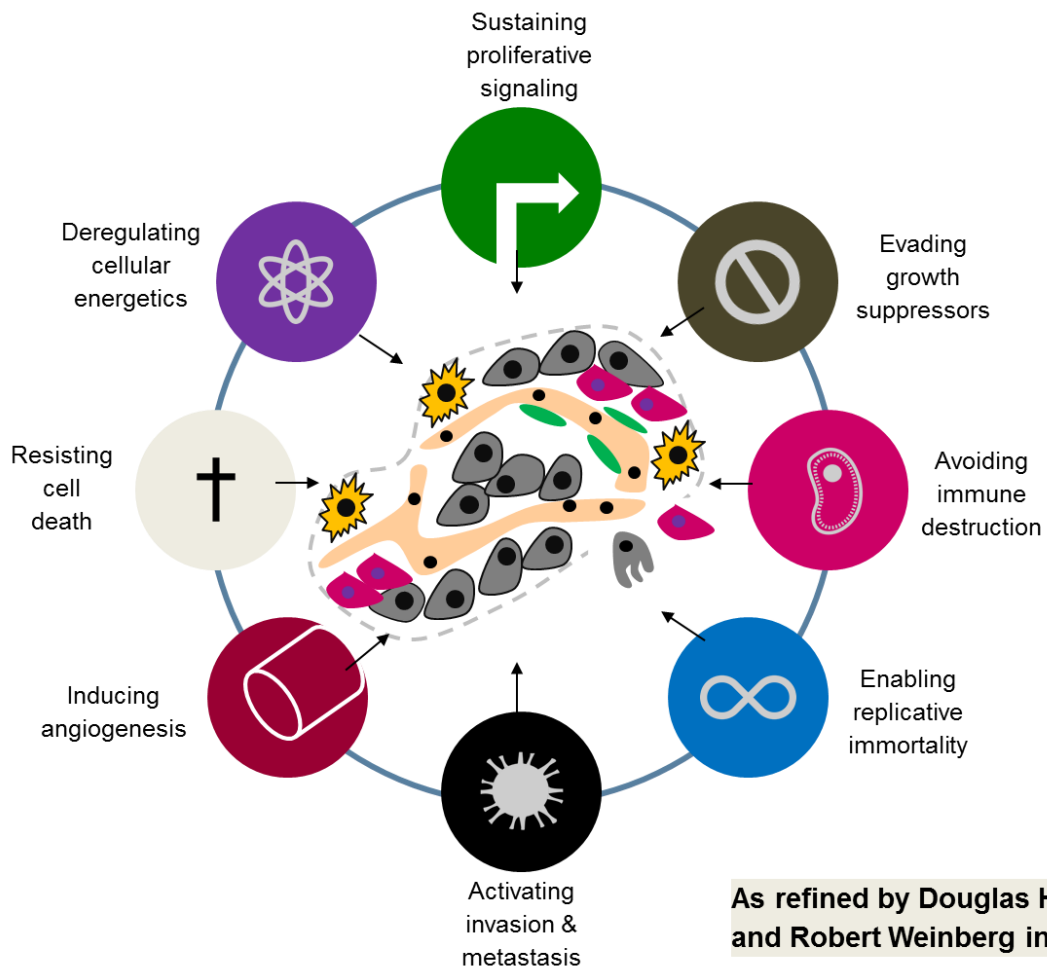
Underlying these hallmarks are genome instabilities, which generate the genetic diversity that expedites their acquisition and inflammation, which foster multiple hallmark functions. Conceptual progress in the last decade has added two emerging hallmarks of possible generality to this list—reprogramming of energy metabolism and evading immune destruction.

In addition to cancer cells, tumors exhibit another dimension of complexity: they contain a repertoire of recruited, ostensibly normal cells that contribute to the acquisition of hallmark traits by creating the “tumor micro-environment”.

Recognition of the widespread applicability of these concepts will increasingly affect the development of new means to treat human cancer.

(Source: <https://thecancercureexperiment.com/51-2>)

Hallmarks of Cancer

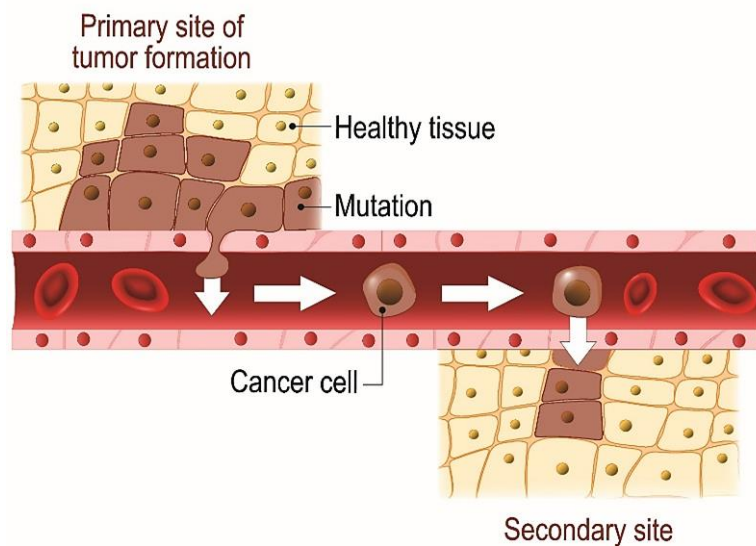


Pict. 25: Hallmarks of Cancer
generated based on refined data from Hanahan, D., & Weinberg, R. A. (2011).
Hallmarks of cancer: the next generation. *cell*, 144(5), 646-674

Carcinogenesis

Metastasis

A schematic depiction of the metastasis process which involves cells detaching from the primary tumor, entering the blood or lymph circulation and eventually exiting and reseeding in the secondary site.



Pict. 26: Schematic courtesy of Wirtz et al.

Metastasis is a pathogenic agent's spread from an initial/primary site to a different/secondary site within a body. The newly pathological areas are called metastases. It is generally differentiated from cancer invasion, which is the direct extension and penetration of cancer cells into neighboring tissues.

Metastasis depends on many different factors, such as the type of tumor, the tumor properties, the tumor size, the tumor localization and many others.

Etiology and Risk Factors

Etiology

The three „C“ of Etiology:

- Correlation
- Cause-Consequence Correlation
- Causal relation

| Risk Factor | Estimated proportion on Carcinogenesis | Organs at risk |
|----------------------|--|--|
| Smoking | 25 - 30 % | Oral cavity, esophagus, larynx, lungs, pancreas, urinary bladder, cervix, kidney, blood |
| Nutrition | 20 - 40 % | Oral cavity, esophagus, larynx, pancreas, stomach, intestines, breast, prostate |
| Alcohol | 3 % | Oral cavity, pharynx, esophagus, larynx, liver |
| Occupational factors | 4 - 8 % | Lungs, bladder, lymphatic system |
| Genetic factors | 5 % | Eye, intestine, breast, ovaries, thyroid |
| Infections | 5 % | Liver, cervix, lymphatic system, hematopoietic system, stomach, nasopharynx |
| Air pollutants | 2 % | Lung |
| Ionising radiation | 1 - 2 % | Blood, breast, thyroid, lung, skin (ultraviolet radiation), bone, intestine, esophagus, stomach, liver prostate, bladder, brain, spinal cord |

Causes of Cancer

The International Agency for Research on Cancer (IARC) analyzes what can cause cancer in humans. The World Health Organization (WHO) authority has divided the study into five categories:

"carcinogenic" (1),

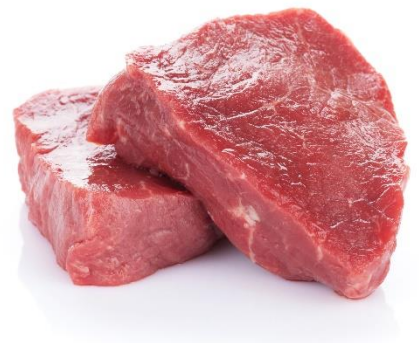
"probably carcinogenic" (2A),

„possibly carcinogenic“ (2B),

"not to be classified" (3),

"not carcinogenic" (4).

Red meat is categorized as „carcinogenic“, just like asbestos. It is important to convey the information, that not the degree of carcinogenicity is being categorized, but the fact that the substances have a carcinogenic effect! Not all substances of the same category are equally „dangerous“.



Causes of Cancer

What are causes?

15% spontaneous mutations,

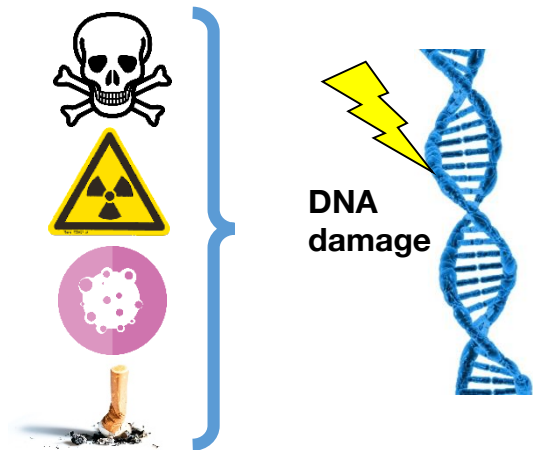
5% inherited genetic defect,

80% environmental influences

(z. B. smoking, diet)

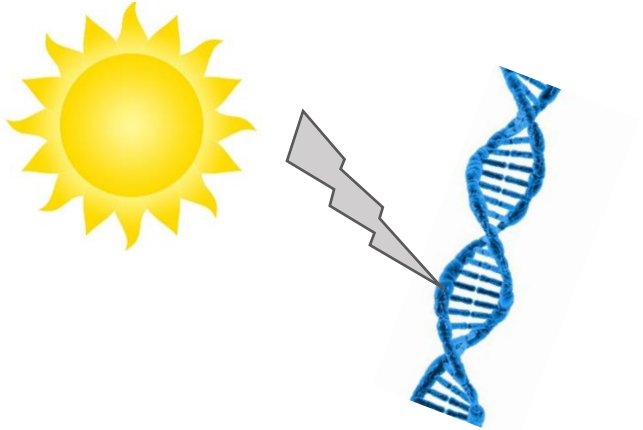
Causes of damage to the genetic material

- Chemical carcinogens
- Ionisated radiation
- Virus
- Environmental factors



Ionisated Radiation

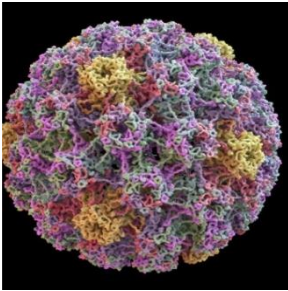
Sunbathing leads to premature skin aging



Sunburns, especially in children and adolescents up to the age of 15, increase the risk of skin cancer many times over.

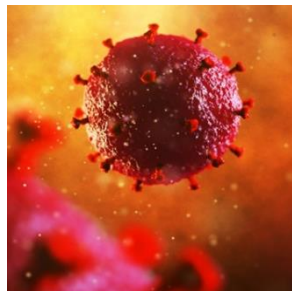


Carcinogenic Virus Types



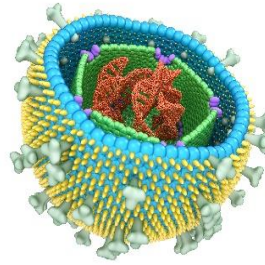
Papilloma virus

carries genes that interfere with the control of cell division; uncontrolled proliferation; Warts (benign) or uterine cervical cancer



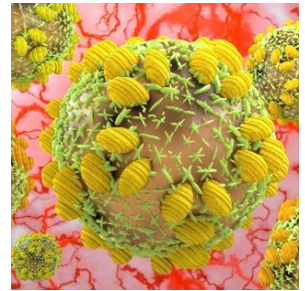
HIV-Virus

Destroys the immune system; Kaposi's sarcoma; allows the development of a second infection with HHV-8



Epstein-Barr-Virus

Virus that attacks the B lymphocytes = Burkitt's Lymphoma



Hepatitis-B-Virus

Pict. 27. Direct DNA damage or influence as a tumor promoter; other factors are partly responsible - virus only triggers certain steps of carcinogenesis.

Further influencing factors

1. Infections

15% of all tumors are caused by infections

- Hepatitis-B and liver cancer
- Hepatitis-C and liver cancer
- Papilloma virus and cervical cancer
- Helicobacter pylori and gastric cancer

2. Hormonal status

Some tumor types are stimulated by endogenous hormones in their growth. Hence, in Germany some doctors advise against hormone replacement therapies for some diseases:

Ärzte Zeitung 08.12.2003; Hormone replacement therapy for osteoporosis now limited

Ärzte Zeitung 06.02.2004; Breast cancer: Risky hormone replacement therapy

Stimulating hormones are for example: steroid hormones like testosterone (prostate), estrogen (breast), progesterone (breast). The receptor status is therefore essential for the therapy of breast carcinomas.

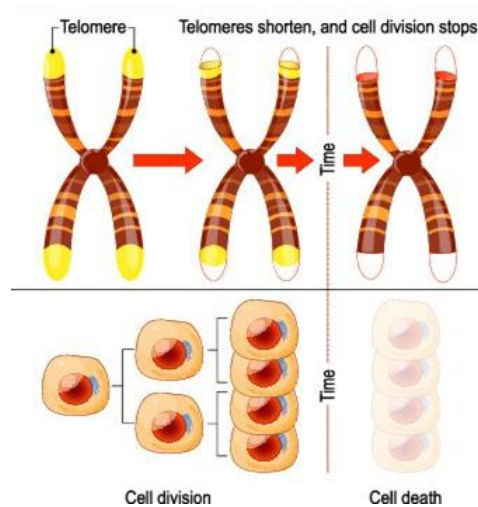
Further influencing factors

3. Biological Age

Shortening of telomeres in old age promotes the development of cancer (cf. with mice).

Telomere Length and Long-Term Endurance Exercise: Does Exercise Training Affect Biological Age? A Pilot Study. Osthus et al. PLoS One. 2012; 7(12): e52769.

- VO_{2max} is positively associated with telomere length and that long-term endurance exercise training may provide a protective effect on muscle telomere length in older people.



Pict. 28. The Aging Process

Take home message:

Physical activity regulates a lot of hormones ☐ also see mechanisms of prevention and physical activity as a protective factor of cancer

Causes of Cancer

$$D + E + A = C$$

Disposition + Exposition + Age = Cancer

Disposition is the acquired susceptibility for the manifestation of a disease. This includes psychological factors! But there is no „cancer-prone“ personality!

Exposition: exposing yourself to risk factors

This leads to the following approaches and principles against cancer-development:



- Don't smoke
- Avoid being overweight
- Be more active
- Eat more fruits and vegetables, less fat
- Drink less alcohol
- Avoid a too intense sun exposure
- Be mindful at the work place

Take home message:

20% is pure chance und preset, 80% is influenceable ☒ sticking to protective factors and avoiding risk factors is not a guarantee not to get cancer

Cancer-prone personality

- Already in the ancient times Hippocrates assumed a connection between cancer and psychological problems, but there is no evidence for a cancer-prone personality.
- Psychological afflictions do not influence the development of cancer, but cancer influences the development of psychological disturbances.
- But it is proven, that there are interactions between the immune system and psychological factors: Psychoneuroimmunology.
- If at all, this only shows indirect connections of psychological factors and cancer. It does not show any causations.
- The diagnosis of cancer alone can be a huge psychological stressor for some patients
 - ❓ there is not a lot of time to consider the possibilities: therapy is beginning really fast
 - ❓ stress
- Studies show that 3 years after the end of a therapy 40% of the cancer survivors are still fighting with anxiety and fear and 20% have depressions especially young women who had breast carcinomas.
- There are correlations to quality of life and fatigue.

Cancer related fatigue

Fatigue

Exhaustion, that cannot be compensated by relaxation, sleep and rest.

Can be seen in 60-80% of all cancer patients,

up to 90% during acute therapy,

up to 50% chronically after therapy.

Therapy:

No influence of medication, but improvements via regular physical activities and movement. In addition psycho-oncological methods to increase the quality of life, to reduce stress, anxiety and despair, also the development of coping strategies.

Symptoms:

reduced physical capabilities, increased need for sleep (also in daytime), a persistent tiredness, heavy extremities, first signs of a depression, lack of motivation



Cancer related fatigue

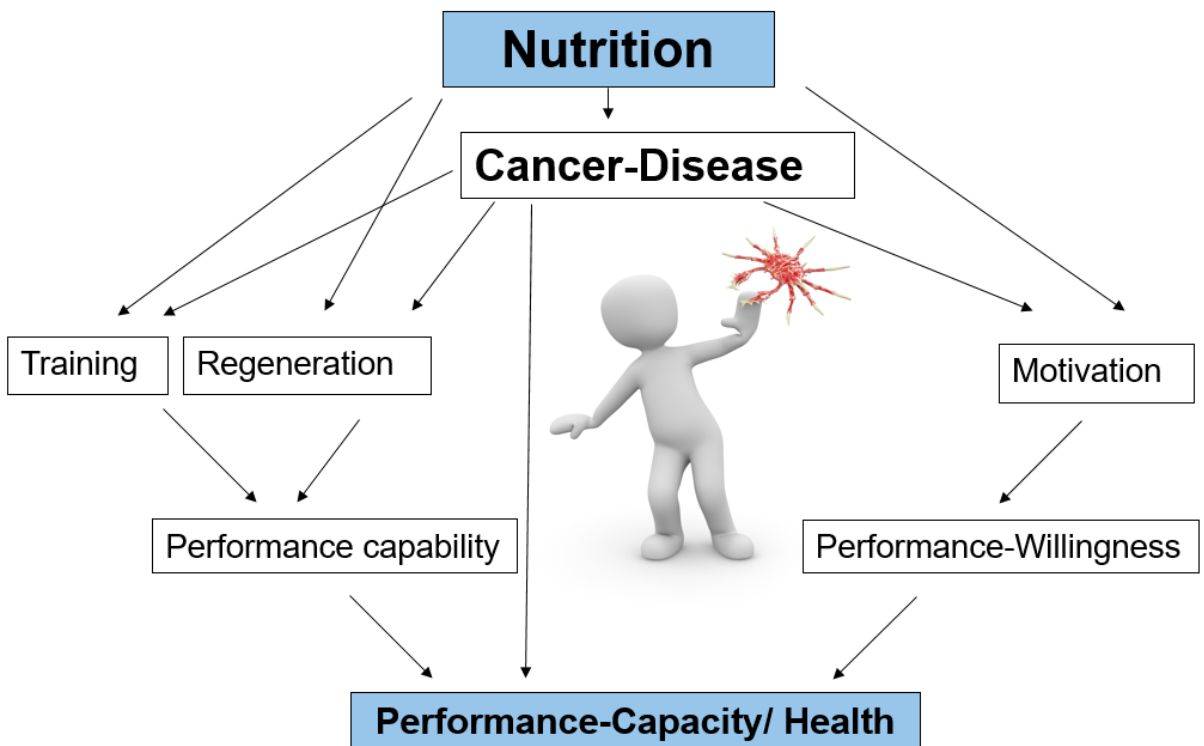
- Because of its persistence, fatigue is often described as one of the most severe side effects of cancer by the patients (and their relatives/friends).
- Because of the high amount of tiredness and the losses of physical capabilities the approaches to physical activity and motivational aspects play a huge role when working against fatigue.
- There are no explicit recommendation for physical activities, but a lot of different recommendations. At the end they are all in correspondence with the standards of endurance and strength training. Currently there is a study investigating the “optimal training structures” (FatiGo-Study in Cologne), where they are testing with 3x30 minutes a week.

Cachexia

- Changes in body weight after the point of diagnosis
- Studies show:
 - Obesity and weight gain after the point of diagnosis are associated with a worse outcome. Weight loss of >10% of BW within the first 6 months is also associated with a worse outcome.
- Approximately one in two patients is affected by Cachexia. Some types of cancer in the head and throat area and of the gastrointestinal tract even more: in highly malign (extremely aggressive non-Hodgkin lymphomas) and in some small-celled forms of lung cancer.
- Reasons for cachexia are multifactorial. It can be caused directly by the cancer or by the therapy (e.g. chemo-therapy).
- Loss of bodyweight in form of body fat and muscle tissue
 - ❓ Malnourishment can occur in every stage
 - ❓ for a lot of patients this already begins before the point of diagnosis
(lack of appetite, changes in metabolism)
 - ❓ cancer leads to inflammation
 - ❓ cytokines of the immune system are released
 - ❓ influence on metabolism

Weight loss due to malnourishment

- Malnourishment is often accompanied by a lack of appetite and an impaired quality of life.
- Detrimental consequences for the patient's health status are implied. Affected patients are more prone to diseases such as pneumonia, urinary tract infections and wound healing disorders.
- Experts assume, that malnourishment itself lowers the life expectations.
- Cancer induced weight loss worsens the prognosis of the cancer disease.



Pict 29. Correlations between nutrition and health

Diets during cancer

ESPEN Guidelines



All cancer patients should be screened regularly for the risk or the presence of malnutrition. In all patients – with the exception of end of life care – energy and substrate requirements should be met by offering in a step-wise manner nutritional interventions from counseling to parenteral nutrition. However, benefits and risks of nutritional interventions have to be balanced with special consideration in patients with advanced disease. Nutritional care should always be accompanied by exercise training. To counter malnutrition in patients with advanced cancer there are few pharmacological agents and pharmaconutrients with only limited effects. Cancer survivors should engage in regular physical activity and adopt a prudent diet.

Diets during cancer

Is a certain diet necessary?

A lot of “cancer-diets” are based on the assumption that the body lacks certain nutrients and/or has an excess of others. That is why these diets are conceptualized like that:

- The lack of nutrients is corrected, the excess is avoided or the tumor is even “starved out”.
- The underlying theories behind these diets are not in line with the actual research. It is not very likely that these diets will have an effect on the cancer development or that they can even prevent the growth of a tumor.
- Fasting cures and diets are usually extremely restrictive. This way they are more detrimental to the patients than helpful.
- Patients following a strict vegan diet will probably experience an initial weight loss. Some cancer patients simply can’t afford that.

Take home message:

Fasting cures may be acceptable for healthy individuals, but not for seriously ill cancer patients and especially not during acute therapy. Negative examples for those diets are Buchinger’s therapeutic fasting or F.X. Mayr’s cure.

Cancer Prevention

Cancer prevention by exercise

Correlations between physical activity and sports have been verified for certain types of cancer in epidemiological studies, particularly for breast and colon cancer. The data is not definitely conclusive for each type of cancer, but positive effects seem to be very likely. It is also important to note that not every breast cancer is equal to the other. A lot of new data has arisen and numbers have changed over the course of the last 20 years. The most notable reductions have been shown in patients with colon cancer.



Pict 30. Human colon

Cancer Prevention

Cancer prevention by exercise

Meta analysis of 170 epidemiologic studies:

| Cancer Type | Classification | Middle Relative Risk Reduction |
|-----------------------|---|---|
| Colon Cancer | Colon: convincingly reduced risk Rectum: probably no connection | Colon: 20-30% Rectum: - |
| Breast Cancer | Premenopausal: probably reduced risk Postmenopausal: likely reduced risk | Premenopausal: 10-20% Postmenopausal: 20-30% |
| Endometrium Cancer | Likely reduced risk | 20-30% |
| Prostate Cancer | Probably reduced risk | 10-20% |
| Lung Cancer | Probably reduced risk | 10-30% |
| Pancreatic Cancer | Probably reduced risk | 20-30% |
| Other types of cancer | No sufficient evidence for proper classification | |

Pict. 31 Physical activity and risk of cancer. Overview of the epidemiological evidence for the primary preventive effects of exercise on the risk of cancer based on the World Cancer Research Fund (WCRF), American Institute for Cancer Research (AICR) and Courneya and Friedenreich

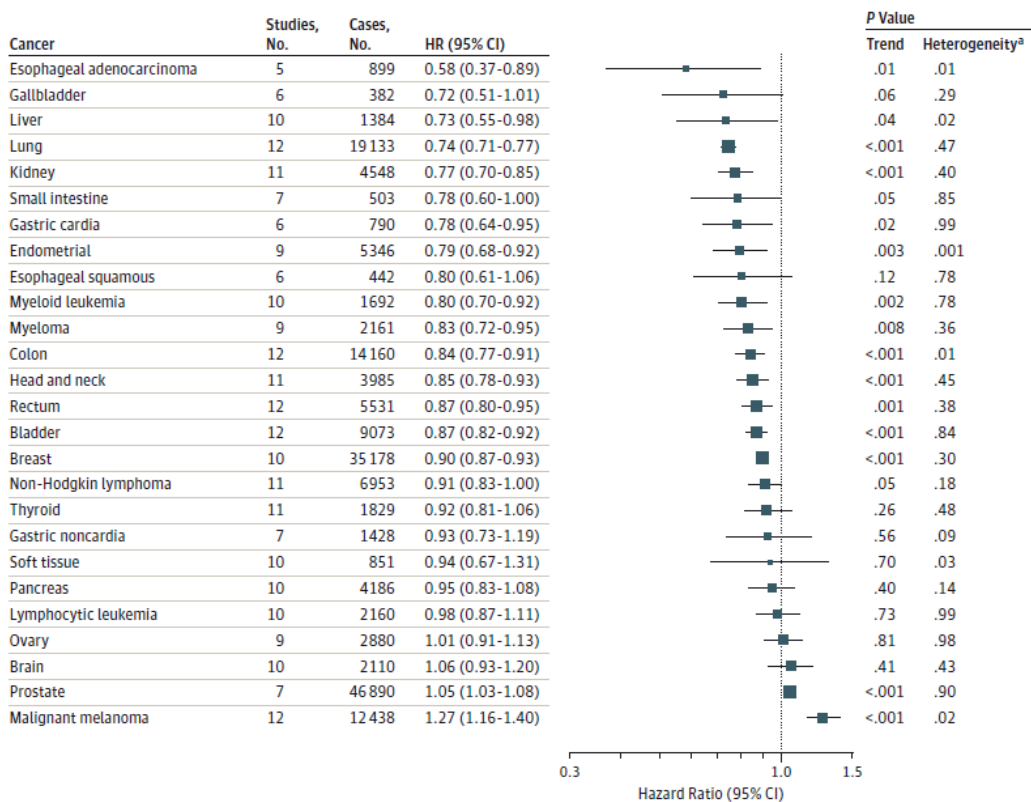
Cancer and physical activity

Physical activity reduces the risk of several cancers

Original Investigation

Association of Leisure-Time Physical Activity With Risk of 26 Types of Cancer in 1.44 Million Adults

Steven C. Moore, PhD, MPH; I-Min Lee, MBBS, ScD; Elisabete Weiderpass, PhD; Peter T. Campbell, PhD; Joshua N. Sampson, PhD; Carl M. Kitahara, PhD; Sarah K. Keadle, PhD, MPH; Hannah Arem, PhD; Amy Berrington de Gonzalez, DPhil; Patricia Hartge, ScD; Hans-Olov Adami, MD, PhD; Cindy K. Blair, PhD; Kristin B. Borch, PhD; Eric Boyd, BS; David P. Check, BS; Agnès Fournier, PhD; Neal D. Freedman, PhD; Marc Gunter, PhD; Mattias Johansson, PhD; Kay-Tee Khaw, MD, MSc, PhD; Martha S. Linet, MD; Nicola Orsini, PhD; Yikyung Park, ScD; Elio Riboli, MD; Kim Robien, PhD; Catherine Schairer, PhD; Howard Sesso, ScD, MPH; Michael Spriggs, BS; Roy Van Dusen, MS; Alicja Wolk, DMSc; Charles E. Matthews, PhD; Alpa V. Patel, PhD



Picture 32: Moore, S. C., Lee, I. M., Weiderpass, E., Campbell, P. T., Sampson, J. N., Kitahara, C. M., ... & Adami, H. O. (2016). Association of leisure-time physical activity with risk of 26 types of cancer in 1.44 million adults. *JAMA internal medicine*, 176(6), 816-825.

Association does not prove causation but physical activity is associated with a reduced cancer risk in most cancers with the exception of malignant melanoma.

Cancer Prevention

The effects of physical activity



What do the ancient Greeks tell about that?

(**Democritus**, Greek philosopher 460-370 v. Chr.):

"Men in their prayers beg the gods for health, not knowing that this is a thing they have in their own power."

Paulus the „Apostle of sports medicine“ !?

1. Korinther 9

... but I'm running conquer my body ...
tame ... him, ... so I will not be reprehensible
... .. this ... teach.



Preventive effect of sport

Physical activity has a number of different effects on our body, which regulate all kind of processes:

In particular, the human metabolism with its 135 different metabolic pathways, more than 830 biochemical reactions, which include more than 600 enzymes, that in return create more that 30.000 different metabolites.

Linked to this are organic changes and psychological changes, that use metabolites. Changes due to physical activity are for example:

- Well-being
- Body-awareness
- Physical requirements
- Dietary behavior
- Immunological functions
- Hormonal environment

Preventive effect of sport

Physical activity has various impacts on a number of diseases. A reduced risk due to physical activity and an increased risk due to a sedentary lifestyle has been shown for years. The ACSM and the EIM (Exercise is medicine) provide information and studies about that topic. The studies' findings have been implemented into the recommendations of health organizations of different countries.

Take home message:

A lot of things are well-known, but the realization of these findings often fail. This is often accounted for too little motivation or sometimes an inadequate execution for the targeted group.

| Condition | Risk reduction | Strength of evidence |
|---|----------------|----------------------|
| Death | 20-35% | Strong |
| Coronary heart disease (CHD) and stroke | 20-35% | Strong |
| Type 2 diabetes | 35-50% | Strong |
| Colon cancer | 30-50% | Strong |
| Breast cancer | 20% | Strong |
| Hip fracture | 36-68% | Moderate |
| Depression | 20-30% | Strong |
| Alzheimer's disease | 40-45% | Moderate |

Picture 33:

https://www.researchgate.net/publication/302585109_Doctors_should_be_able_to_prescribe_exercise_like_a_drug

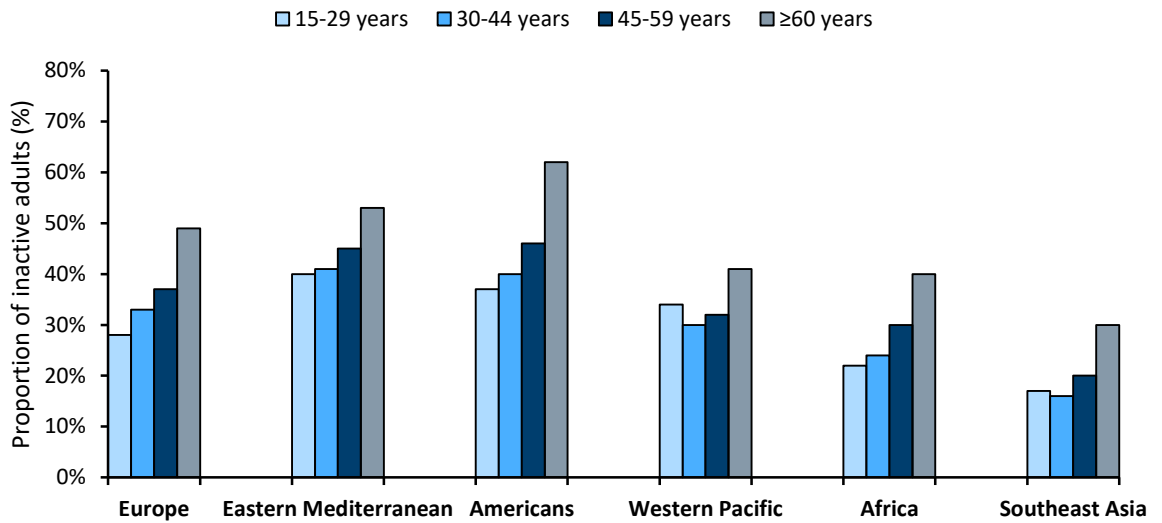
Preventive effect of sport

Physical Activity contribution to reduction in risk of mortality and long term conditions

| Disease | Risk reduction | Strength of evidence |
|---------------------------|----------------|----------------------|
| Premature death | 20-35 % | Strong |
| CHD and Stroke | 20-35 % | Strong |
| Type 2 Diabetes | 35-40 % | Strong |
| Colon Cancer | 30-50 % | Strong |
| Breast Cancer | 20 % | Strong |
| Hip Fracture | 36-68 % | Moderate |
| Depression | 20-30 % | Moderate |
| Hypertension | 33 % | Strong |
| Alzheimer`s Disease | 20-30 % | Moderate |
| Functional limitations | 30 % | Strong |
| Prevention of falls | 30% | Strong |
| Osteoarthritis disability | 22-80 % | Moderate |

Pict. 34: Start Active, Stay Active (2011) based on US Department of Health and Human Services Physical Activity Guidelines Advisory Committee Report, Washington D.C.

Preventive effect of sport



Pict. 35. Physical inactivity in age groups by WHO region (Hallal et al. 2012).

Preventive effect of sport

Physical Inactivity: A Global Public Health Problem

Globally, around 31% of adults aged 15 and over were insufficiently active in 2008 (men 28% and women 34%). Approximately 3.2 million deaths each year are attributable to insufficient physical activity.

Reasons for physical inactivity

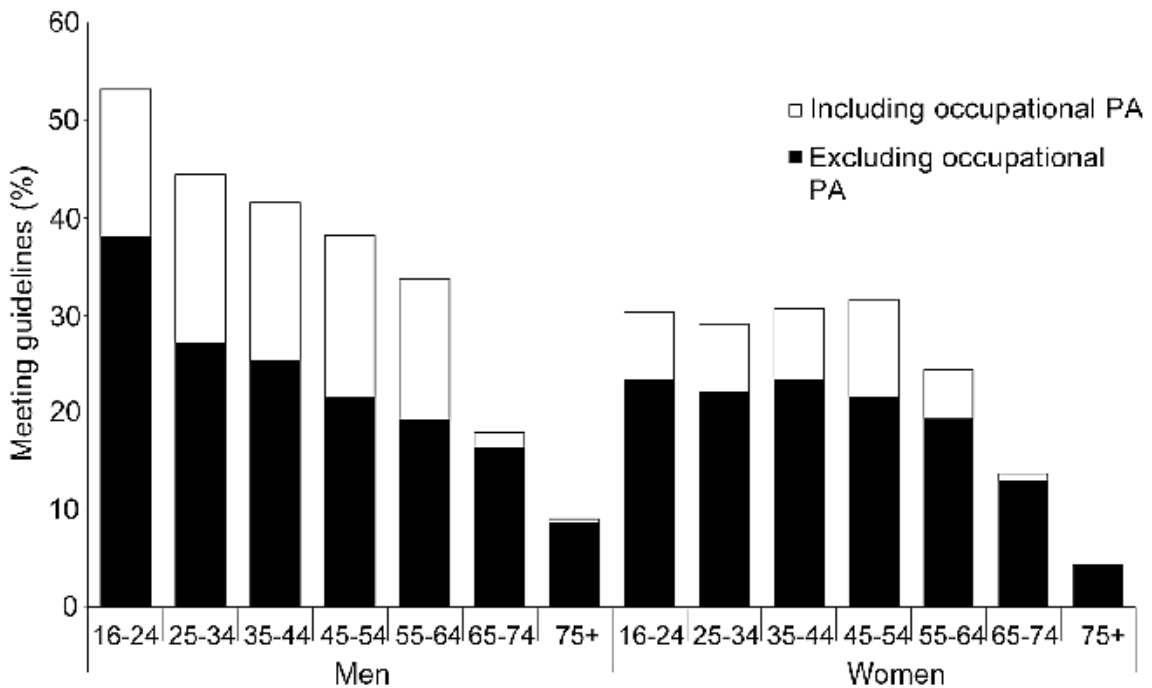
The current levels of physical inactivity are partly due to insufficient participation in physical activity during leisure time and an increase in sedentary behaviour during occupational and domestic activities.

Likewise, an increase in the use of "passive" modes of transport has also been associated with declining physical activity levels.

Increased urbanization has resulted in several environmental factors which may discourage participation in physical activity such as:

- violence
- high-density traffic
- low air quality, pollution
- lack of parks, sidewalks and sports/recreation facilities.

Preventive effect of sport



Pict. 36: Percentage of men and women in different age groups meeting physical activity guidelines of 150 min/week; https://www.who.int/dietphysicalactivity/factsheet_inactivity/en/

Preventive effect of sport

As a preventive measure?

- Are there any epidemiological and experimental studies as a supportive measure directly in therapy?
- Do experimental studies as a rehabilitative measure in therapy and aftercare exist?

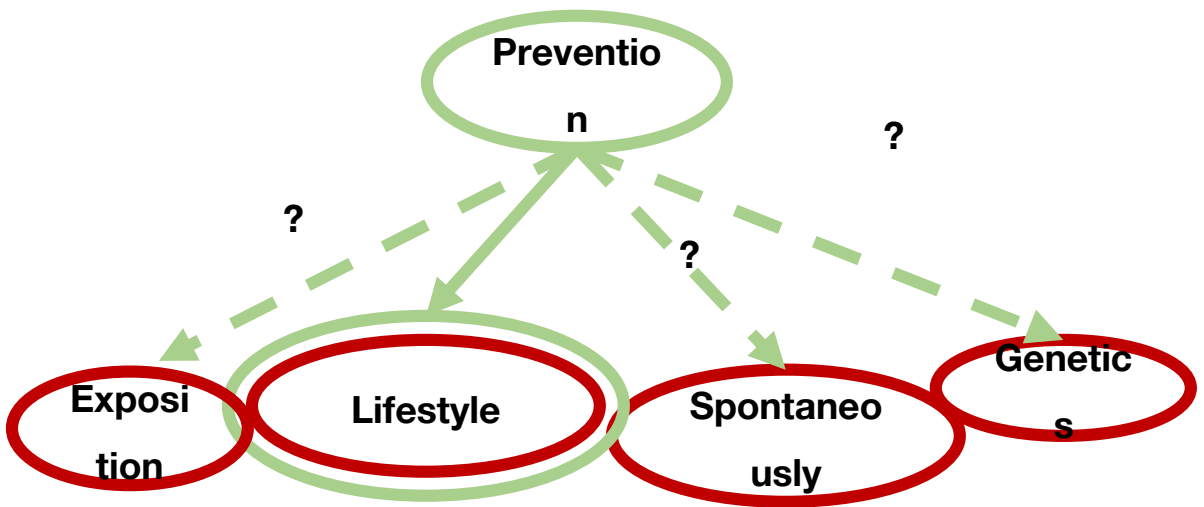


Dr. Ernst van Aaken has been a pioneer for postulating correlations between physical activity and cancer in 1969. He relied more on practical than on scientific evidence. He got sneered at from the scientific world and it took several years until Blair et al. could show epidemiologically that individuals who are in better physiological shape have a:

- 7,9 fold lower cardio-vascular mortality
- 2,8 fold lower cancer-mortality

Preventive effect of sport

Triggers of Cancerogenesis



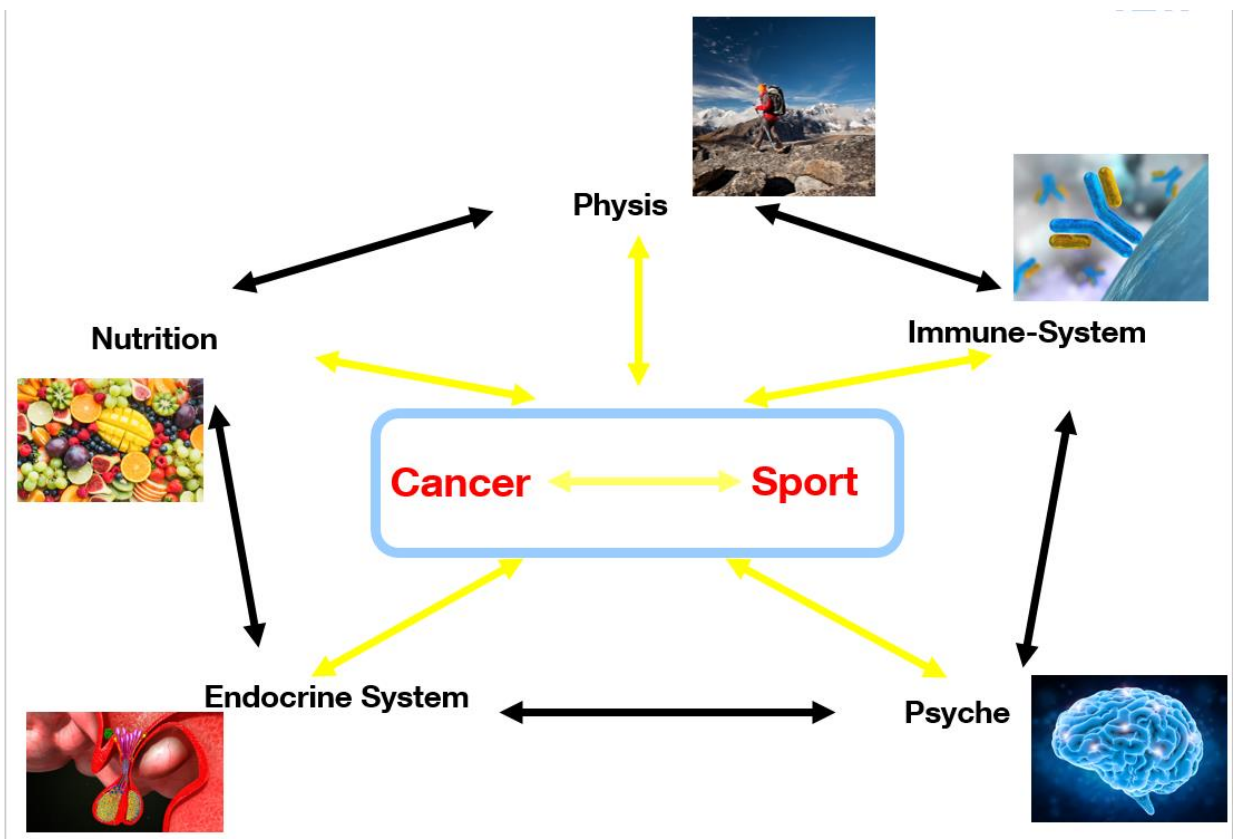
Pict. 37: based on data from Schmitz-Drager, Eichholzer, Beiche & Ebert: Nutrition and prostate cancer. Urol Int. 2001

Which factors can be used for the primary prevention?

The most important factor that can be influenced is the individual's lifestyle. The lifestyle is composed of diet, physical activity, stress management and avoidance of tobacco/smoking and alcohol. Within this context physical activity plays a key part and even has a trigger function. A lot of active people have a different mindset regarding their body and therefore towards their health. Improving one's physical fitness often automatically changes the attitude towards nutrition and stress.

Preventive effect of sport

Being outdoors multiplies the effects of physical activity particularly those regarding the physique, the immune-system and the endocrine system. The effects also transfer to psychological areas and even nutrition. All of these factors also have impacts on each other. This fact makes it hard to prove scientifically which of these factors have the greatest health impact. What matters in the end is the fact, that it does work.



Pict. 38: Correlation of life style factors with cancer and sports

Preventive effect of sport

Does exercise influence the hormone system?

Sports releases stress hormones such as adrenalin and noradrenalin, especially above an intensity of 60% of the individual's VO₂max, when the release is exponentially increased. This way the immune system gets stimulated, which results in the release of cortisol to counteract this reaction. In the meantime immune cells, especially natural killer cells have been patrolling within the body. In the long term steroid hormones, such as testosterone, estrogen and progesterone are being downregulated.

❓ Effect in the hormone dependent tumors

Stress Hormones (Adrenalin, Noradrenalin, Cortisol) ❓ ❓

Endorphine ❓ ❓

Insulin ❓

Estrogen ❓

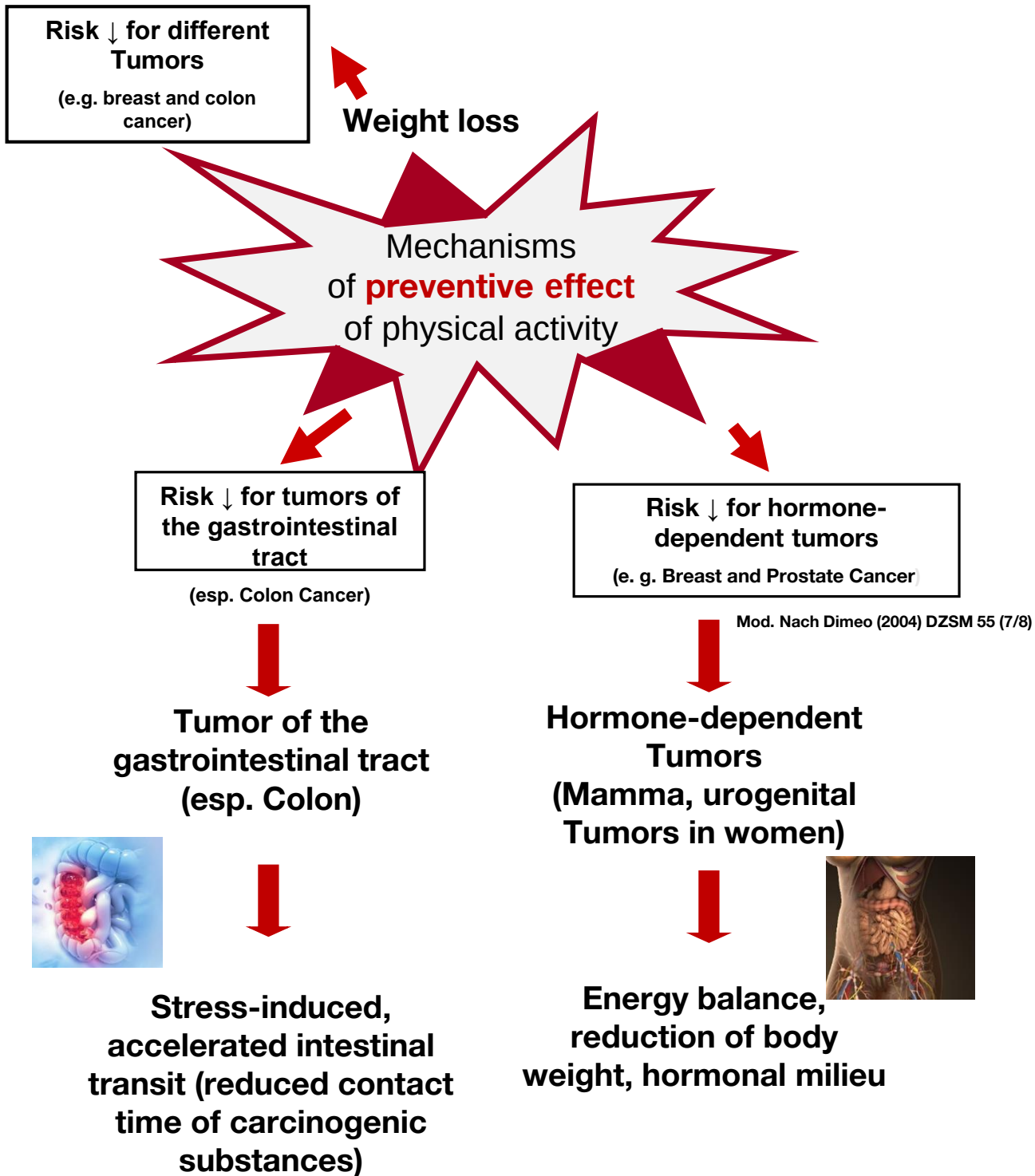
Progesterone ❓

Testosterone ❓



Pict. 39: Hormone regulations based on exercise

Postulated Mechanisms



Possible Mechanisms

Biological and individual factors, genetic predispositions, eating habits and exposure to carcinogenic substances are discussed for a prostate carcinoma genesis (1, 2)



Men with prostate cancer have **higher levels of endogenous testosterone** than healthy men (3)



Regular physical activity leads to a **reduction of sex hormones** in healthy seniors (4)



Training-related **drop in testosterone levels** in the blood

Based on (1) Cerhan JR et al. 1997, (2) Whittemore, AS et al. 1995, (3) Hammond GL 1978, (4) Wheeler GD et al. 1984

Even though there is no conclusive evidence for benefits of physical activity in the prevention of cancer, incorporating physical activity in the aftercare has been well investigated. Since the therapy against prostate cancer has a lot of side effects including incontinence.

Training of the pelvic floor plays a major role here.

Preventive effect of sport

During therapy

Animal studies showed the following results:

- Regular physical activity was protective against various types of induced cancer.
- Carcinogens were administered: subcutaneously, intra peritoneal, intra gastrical, implantations of tumors and infusions of tumor cells.
- As a result of physical activity:
 - Reduction in size/weight of the tumor
 - Reduction in incidence and metastasis

Take home message:

Positive effects of physical activity have been well proven in animal studies. This is true for a lot of types of cancer and under different circumstances. Those studies are required to test physical activity for therapeutic concepts.

Preventive effect of sport

Overview

- High physical activity can reduce breast tumor growth
- Immune functions can be activated by intense physical activity
- Metastasis can be suppressed by physical activity
- The success of hormone therapy is not adversely affected by physical activity

Memo:

The study of Hojman et al., which was published in Cell Metabolism, serves as a good overview on what effects physical activity and exercise have on cancer. Those who are interested in molecular information find a lot of useful information and graphic images on this topic.

Hojman et al., Molecular Mechanisms Linking Exercise to Cancer Prevention and Treatment, Cell Metabolism (2017) [https://www.cell.com/cell-metabolism/fulltext/S1550-4131\(17\)30567-3](https://www.cell.com/cell-metabolism/fulltext/S1550-4131(17)30567-3)

Positive effects of exercise

Positive effects of exercise consist of:

- (1) Acute training sessions lead to physical (increased blood flow, shear stress on the vascular bed, temperature increases, sympathetic activation) and endocrine (release of catecholamines and exercise hormones, myokine secretion) regulations that result in increased tumor perfusion, oxygen delivery, intra-tumoral metabolic stress, cellular damage, and ROS production. These acute changes are able to elicit signaling pathways that prevent metastasis.
- (2) Chronic training adaptations comprise systemic alterations with improved immune function, reduced systemic inflammation, and improved metabolic health, as well as intra-tumoral changes in the form of enhanced blood perfusion, immunogenic profile, and immune cell infiltration.

Hojman et al., Molecular Mechanisms Linking Exercise to Cancer Prevention and Treatment, Cell Metabolism (2017) [https://www.cell.com/cell-metabolism/fulltext/S1550-4131\(17\)30567-](https://www.cell.com/cell-metabolism/fulltext/S1550-4131(17)30567-3)

[3](https://www.cell.com/cell-metabolism/fulltext/S1550-4131(17)30567-3)

Positive effects of exercise

| Parameter | Impact | Effect |
|---------------------------------------|--------|---|
| Maximal oxygen uptake | ↑ | Higher aerobe endurance capacity |
| Heart rate at defined load | ↓ | Higher aerobe endurance capacity |
| Hemoglobin-/ Hematocrit concentration | ↑ | Improved Oxygen transport capacity, possibly shorter hospital stay |
| Lung function | ↑ | Improved ventilation |
| Muscle Strength | ↑ | Construction of muscle corset |
| ADLs | ↑ | Maintaining or increasing autonomy |
| Mobility | ↑ | Reduction of limited mobility |
| Nausea, vomiting, diarrhea | ↓ | Improved therapy compatibility |
| Immune system | ↑ | Improved defense function |
| Body weight | ↓ | Improved energy balance |
| Body awareness | ↑ | Improved sensibility of performance and limitations of one's own body |
| Fatigue-Syndrome | ↓ | Improved load-bearing capacity |
| Quality of Life | ↑ | Improved well-being and joy of life |
| Fears and Depression | ↓ | Improved disease management |

Pict. 40: based on Hojman et al., Molecular Mechanisms Linking Exercise to Cancer Prevention and Treatment, Cell Metabolism (2017) [https://www.cell.com/cell-metabolism/fulltext/S1550-4131\(17\)30567-3](https://www.cell.com/cell-metabolism/fulltext/S1550-4131(17)30567-3)

Positive effects of exercise

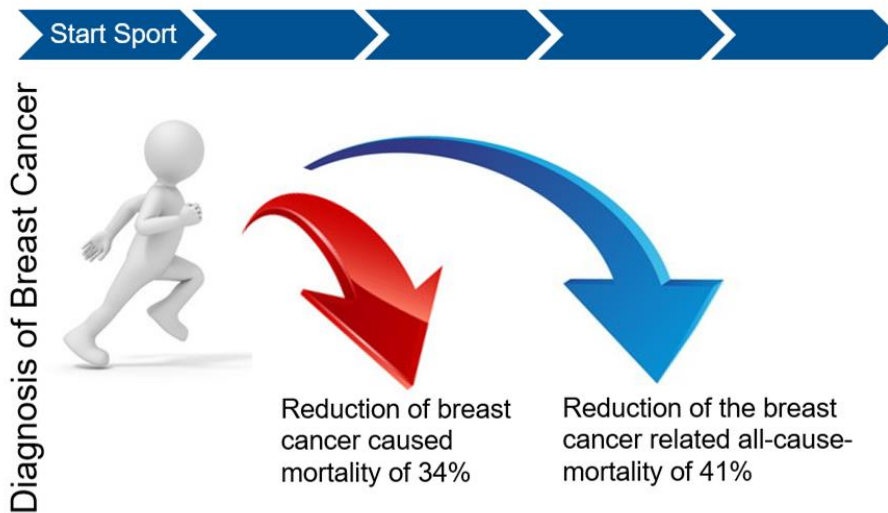
Studies on effect of exercise on prostate cancer

| Year / authors | Number of patients | Training | Result |
|---------------------|--|---|--|
| Truong et al. 2004 | 28 patients with prostate-CA Under radiation therapy Uncontrolled! | 6-8 weeks Daily walking | Reduction of fatigue |
| Windsor et al. 2003 | 66 patients with prostate-CA during radiotherapy Controlled! | TR: 4 weeks home training 3x / week each 30min aerobic endurance training (walking) | Increase in performance Lower increase in fatigue in the TR group |

Different Cancer forms and the impact of exercise on a longer life

| | Year / authors | Number of patients examined | Result |
|-------------------------|------------------------|--------------------------------|--|
| Breast Cancer | Holmes et al. 2005 | 2987 Women | Risk reduction by 26 - 40% for death, death from breast cancer, recurrence |
| Colon and Rectum Cancer | Meyerhardt et al. 2006 | 573 Women 832 Women and Men | Risk reduction by 50% for death and death from colorectal cancer 47% improvement in relapse-free survival |

Positive effects of exercise



Pict. 41: Ibrahim EM, Al-Homaidh A (2011) Physical activity and survival after breast cancer diagnosis: meta-analysis of published studies. *Med Oncol* 28(3):753-765

- The timing is important for the outcome when it comes to decide when to begin with sports: starting a sports program at the point of the diagnosis reduces the mortality strongly (as shown in graphic).
- If the individual did exercise before the point of diagnosis but stopped when being diagnosed, then there is no effect on the mortality of breast-cancer patients. But there is an effect on the breast-cancer related all-cause mortality and on the recurrence rate.

Take home message: Sport is the most helpful when it is practiced before and after diagnosis, whereas after diagnosis is more important than before.

Positive effects of exercise

What does „exercise“ mean for cancer-patients? How much is enough? Where should it be done?

First of all it is important to define the amount and the intensity. The metabolic equivalent (MET) has been proven as a good instrument for that. Therefore intensity can be compared.

The metabolic unit or metabolic equivalent is used to measure the load (power) via the oxygen consumption. The MET compares oxygen uptake at rest with oxygen uptake during exercise.

Definition:

1 MET corresponds to the oxygen consumption in perfect rest.

- In healthy adults, this is about 3.5 ml of oxygen per kilogram of body weight per minute.
- 1 MET corresponds to a calorie consumption of 1 kcal per kilogram of body weight per hour

The question remains what intensity and what volume to chose for cancer patients. What are the limits and what are the recommendations to start with a sports program?

The intensity of exercise

Metabolic equivalent (MET)

Is an objective measure of the ratio of the rate at which a person expends energy, relative to the mass of that person, while performing some specific physical activity in comparison of reference (rest).

Example:

An average man with 80 kg body weight has approximately a resting metabolic rate of 80 kcal per hour.

10 METs means a calorie expenditure of 800 kcal per hour

| Type of sport | MET |
|-------------------------|-----|
| Lie still | 1 |
| Play golf | 3 |
| Walking | 3 |
| Dancing | 3 |
| Housework | 3,5 |
| Table tennis | 4 |
| Walking: 5 km/h | 4 |
| Gardening | 4,5 |
| Swimming: slow | 4,5 |
| Inline skating: 13 km/h | 5 |
| Tennis | 5 |
| Cycling | 6 |
| Swimming 1500 m/h | 6 |
| Dancing (intensive) | 7 |
| Skiing | 7 |
| Cycling: 24 km/h | 8 |
| Running: 11 km/h | 11 |
| Squash | 12 |
| Running: 14 km/h | 14 |



Stories

- Lance Armstrong survived his cancer therapy after testicular cancer. He won the Tour de France (3500km) multiple times afterwards. At the point of diagnosis he already had metastases in his stomach, lung and brain (chance of survival 50%).
- Henriette Thompson broke the world record for half-marathon for her age at the age of 92. She survived two cancer-diseases.
- Heidi Sand: Colon cancer in advanced state. 30cm of her colon was removed. She started training during cancer therapy.
2014: First woman on the Makalu (8485m).
2015: Ascent of the Eiger

Memo: Please insert here samples from your country!

Preventive effect of sport

- Many studies figured out that compared to sedentary lifestyle, physical activity (PA) is associated with a lower risk of mortality for all causes and can be set in a linear context.
- At maximum energy conversion of 3500 kcal / week, the relative risk could be reduced linearly to 50% compared to the least active.
- E.g. a training intensity of 750 kcal/h for 4-5 hours per week, e.g. cycling 4-5 times per week for more than one hour at 25 km/h

(Source: Paffenbarger et al. (1986) N Engl J Med 314:605–613)



Preventive effect of sport

A comparison between physical active to inactive employees

- Inactive employees have a 30-40% higher risk of a heart attack than employees who burn at least 1000 kcal/week in the form of physical activity.
- No further reduction in mortality beyond this 1000 kcal/week (!)

(Source: Marra et al. (1985) Eur Heart J 6:656–663)

Take home message:

Even though the studies are old it can be compared that there is a maximum to the benefits of physical activity. It also shows that the health benefits have a limit. 1000kcal/week means a reduction of 30-40%, a 3.5 fold higher effort does “only” increase the benefit to 50%. The additional effort is not in relation to the additional benefits, but it is nevertheless important for the motivation of the individual. Scientific and practical reasons have to be weighed in this context.

Recommendations

- Long time recommendations for exercise are available aiming the best training adaptation and reducing the risk for disease. The German cardiac society published this position statement in 2005:
...four to five times weekly activities over 30 - 45 min. Moderate intensity in the form of walking, jogging, cycling or other endurance exercise are desirable.
- On the one hand, the intensity of the endurance activity should approach the individual's performance limit, but on the other hand, allow a little conversation along the way. More activity in everyday life is cheap, such as walking during work-breaks, climbing stairs instead of elevator and gardening. Any extra physical stress beyond the daily activities has a favorable effect.
- WHO and also individual countries give recommendations for physical activity (the countries often in reference to the WHO).



Recommendations

Memo:

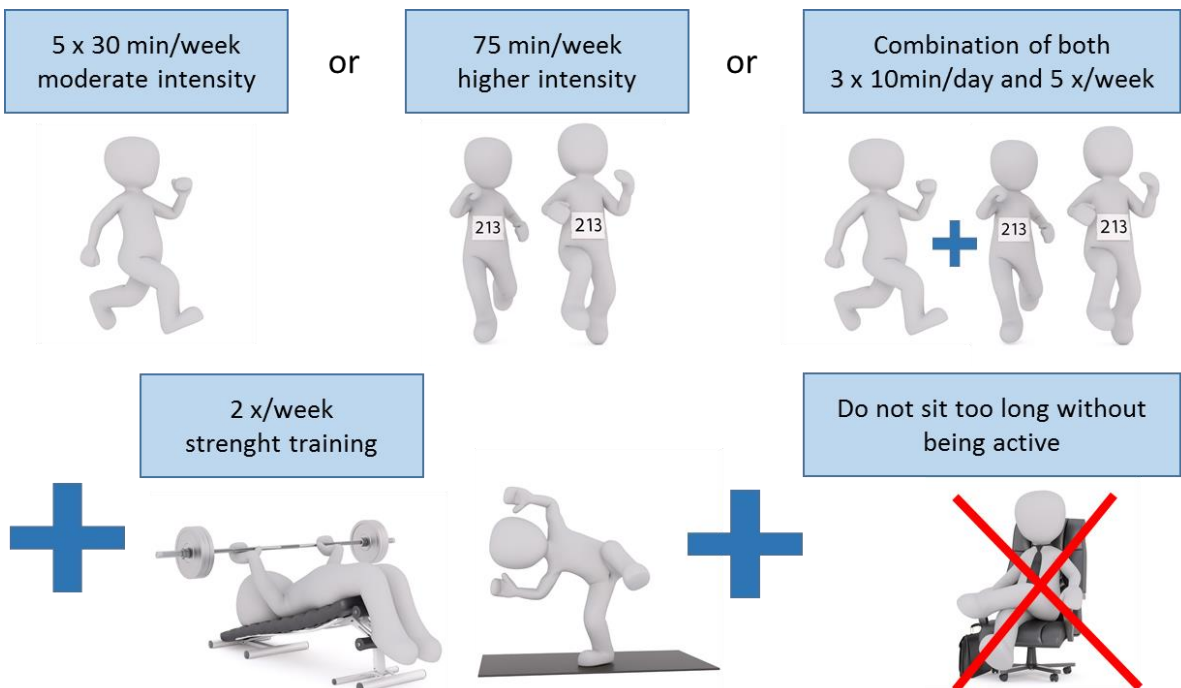
The national recommendations have to be researched by the trainers of each country.

- For Germany for example they can be obtained here:

https://www.bundesgesundheitsministerium.de/fileadmin/Dateien/3_Downloads/B/Bewegung/Nationale-Empfehlungen-fuer-Bewegung-und-Bewegungsfoerderung-2016.pdf

- Austria:

<https://www.gesundheit.gv.at/r/leben/bewegung/gesund-durch-sport/Bewegungsempfehlungen-Erwachsene.pdf?pamIta>



Pict. 42: Recommendations on physical activity

Recommendations in Germany

- Adults should regularly engage in physical activity. Important health benefits can be achieved and risks of getting a chronic disease can be decreased
- Being active in even only small extents can already give benefits in comparison to being inactive. Additional physical activity is associated with additional benefits. Every step away from a sedentary life is important and supports your health.
- To maintain a healthy lifestyle or to increase it, there are the following minimum recommendations:
 - Adults aged 18–64 should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week
 - or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity activity.
 - Aerobic activity should be performed in bouts of at least 10 minutes duration.
 - Muscle-strengthening activities should be done involving major muscle groups on 2 or more days a week.
 - Long periods of sitting should be avoided or interrupted by physical activity
 - The health benefits can be further increased by increasing the volume or the intensity

Recommendations in Germany

- For some individuals these recommendations can be rather deterring. Hence, of much greater importance is the message, that the most benefits are being achieved during the first 15 minutes of physical activity (maybe because those are the only minutes)!
- Any activity is better than none. Those first 15 minutes have a greater impact than activities past 60 minutes, especially if 60 minutes are not realistic due to physical impairments.
- In the long-term health-benefits should be treated accordingly: “more helps more” but the biggest benefits are seen when starting physical activity.

Source:
https://www.bundesgesundheitsministerium.de/fileadmin/Dateien/3_Downloads/B/Bewegung/Nationale-Empfehlungen-fuer-Bewegung-und-Bewegungsfoerderung-2016.pdf

Take home message:

Go outside and just get started, because even a little bit can have a huge impact on physical and psychological aspects of your health. Physical activity and physical fitness are predictors for the mortality. Being able to walk more than 400m in 6minutes (or less) is an achievable goal and can mean so much.

6 min Walk Test

Endurance tests: 6 Minutes Walk Test

The subject / patient is encouraged to walk as far as possible in 6 minutes in a speed that can be sustained over the period.

| 6 Min WalkTest | | |
|------------------------|-------------------------------------|-----------------------------------|
| Normal Range of Scores | | |
| Age | Distance covered by Women in meters | Distance covered by Men in meters |
| 60 – 64 | 498-603 | 558-673 |
| 65 – 69 | 457-580 | 512-640 |
| 70 – 74 | 439-571 | 498-622 |
| 75 – 79 | 398-535 | 430-585 |
| 80 – 84 | 352-454 | 407-553 |
| 85 - 90 | 311-466 | 347-521 |

Survival rate of lung cancer patients is higher in individuals who covered a longer distance in the 6min Walking Test

Source: Win, T., Jackson, A., Groves, A. M., Sharples, L. D., Charman, S. C., & Laroche, C. M. (2006). Comparison of shuttle walk with measured peak oxygen consumption in patients with operable lung cancer. *Thorax*, 61(1), 57-60.

Green Environment, Health and Motivation

Gladwell *et al. Extreme Physiology & Medicine* 2013, 2:3
<http://www.extremephysiolmed.com/content/2/1/3>



REVIEW

Open Access

The great outdoors: how a green exercise environment can benefit all

Valerie F Gladwell*, Daniel K Brown, Carly Wood, Gavin R Sandercock and Jo L Barton

Sports Med (2016) 46:989–995
DOI 10.1007/s40279-016-0502-4



LEADING ARTICLE

The Benefits of Natural Environments for Physical Activity

Danielle F. Shanahan¹ · Lara Franco¹ · Brenda B. Lin² · Kevin J. Gaston³ · Richard A. Fuller¹

Social Science & Medicine 91 (2013) 130–134



Contents lists available at SciVerse ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed



Short report

Is physical activity in natural environments better for mental health than physical activity in other environments?

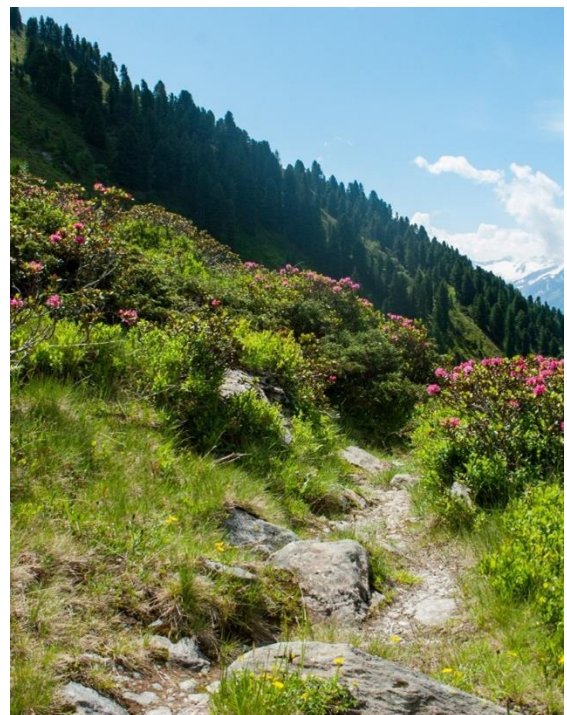


Richard Mitchell

Centre for Research on Environment, Society and Health, Institute of Health and Wellbeing, University of Glasgow, 1, Lilybank Gardens, Glasgow G20 0TY, United Kingdom

Green Environment, Health and Motivation

- A „green environment“ can increase the motivation to get active in the first place.
- Activity in a green environment is psychologically better than indoor activity.
- Participants have a more positive perception of the natural outdoor environment in comparison of the urban constructed environment.
- The sight of a natural environment improves the mood and also slightly improves the concentration, these changes are significantly higher compared to watching an urban environment.

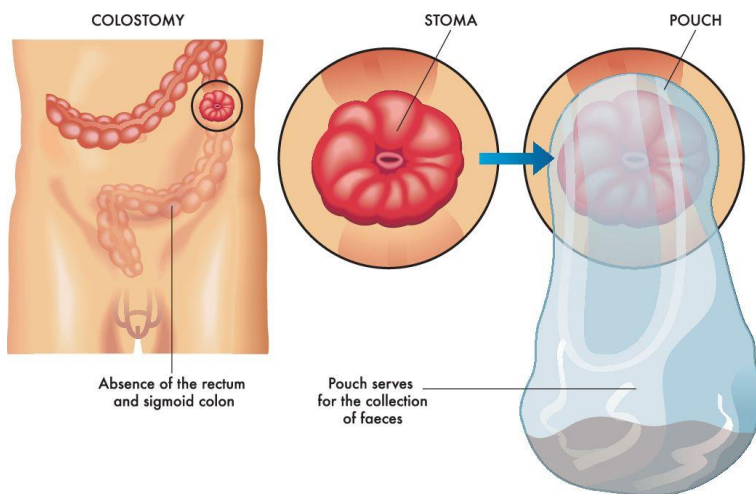


Conclusions

- Cancer diseases are all different and they have different impacts on the patient, also depending on the chosen therapy
- The attitude towards physical activity is different from person to person, but an outdoor environment can boost the individual's motivation
- After the cancer therapy the cancer itself should be eliminated
-> reducing the side effects is a primary goal when initiating an activity program
- Side effects are reduced physical fitness, surgery-dependent limitations, decreased quality of life as a cause of the diagnosis, changes of the psyche
-> those are factors that should be restored
- A severe side effect is fatigue
-> depending on how serious the symptoms are, those individuals won't show up in the groups at the first place due to a lack of drive/power

Conclusions

- Depending on the therapy and comorbidities sport programs are possible
 - > in general cancer patients can do exercise, assuming everything went well during therapy
 - > the trainer might have to adjust exercises to the individuals' conditions
 - > e.g. even swimming with a stoma after colon cancer is possible



Pict. 43: Colon stoma

- Effects of exercise should be/ will be:
 - > Improvement of the endurance performance
 - > Development of a muscle corset
 - > Maintenance/improvement of joint mobility and elasticity of relevant muscle groups
 - > Improving body awareness
 - > Improving the breathing control

Notes

| Objective | Practical content | Remarks on implementation |
|---|--|---|
| Improving endurance performance | Hiking, Nordic walking, Cycling, Running, Swimming, Aqua fitness, Ski tour, Cross-country skiing | Orientation to the subjective feeling of stress: <ul style="list-style-type: none"> - as a bit exhausting - feel good - Straining without a puff |
| Developing a muscle corset: <ul style="list-style-type: none"> - Functional joint protection - Compensation of strength loss in old age - Avoidance of imbalances - Compensation of muscular weaknesses | Strengthening exercises for the abdominal, back, shoulder girdle and gluteal muscles | Training: <ul style="list-style-type: none"> - Train trunk first - Controlled movement execution - Pay attention to proper breathing |
| Maintaining or improving the mobility of the large joints and elasticity of important muscle groups | Loosening and stretching gymnastics | <ul style="list-style-type: none"> - Controlled, slow movement execution - Pay attention to symmetry |
| Improvement of body awareness and respiratory function | Relaxation training, Tai chi, Yoga, Breathing gymnastics | Secure a quiet and relaxed atmosphere |

Notes

Recommendations for practice

- Regular, long-term exercise program should be achieved
 - > in the long-term the physical fitness should be improved
- Integration of endurance exercises
 - > strengthening of the cardiopulmonary system as weakened from therapy in all patients
- Volume of load is important not just intensity
 - > even though intensity can be high, it might not be suitable for each individual, and some simply are not motivated to do high intensity work
- Careful and long-term training structures to ensure training adaptations
 - > otherwise the activity will “only” have a psychological impact
- Suitable choice of movement
 - > everything is possible but adjustments need to be made for the individual and the group
- Do not exaggerate
 - > a long-term training is the main goal, make sure not to scare anybody away by over exaggerating and intensities that are too high

Notes

Recommendations for practice

- Regular long-term exercise programs with moderate exercise intensity (3-5x per week 1 hour)
 - > this is desirable but hard to achieve in daily life (most of the groups only meet once a week)
 - > therefore give “homework”
 - > in the end once a week is better than no activity at all
- Search for suitable forms of movement
 - > Doing adjustments is a vital part, participants are different, intensities need to be adjusted
 - > progressions for fitter individuals, regressions for less fit individuals
- Regeneration is important
 - > it is the requirement for any adaptation, having breaks between training sessions is important
- Endurance in groups is more fun
 - > offering distraction during activities is important especially for less motivated or less experienced individuals
 - > increase the fun factor for more motivation

Notes

Observe contraindications

Always in consideration of the national regulations: Always talk to a doctor before starting a exercise program

- Infection, fever, high temperature ($> 38^{\circ}\text{C}$)
- Vomiting, diarrhea, etc.
- Laboratory values (standard values, no clear limits)
- Leukopenia $< 1.5 \text{ E}^3 / \mu\text{l}$ Platelets $< 50,000 / \mu\text{l}$ Hb $< 8\text{g} / \text{dl}$
- Days of chemotherapy with cardio toxic substances
- Bone metastases (relative contraindications)
- Comorbidities?

Limitations of exercise

- Abstain from sports at the first chemotherapy, patients with experience can estimate for themselves whether and when during chemo therapy sport might support health and quality of life
- Stimulation of the immune system in diseases of the lymphatic or hematopoietic system possible – but without excessive sports training
- Sport can be started after surviving bone marrow transplantation

Examples

Breast Cancer and exercise

- Chest exercises
- Posture training
- Pumping exercises
- No abrupt, torn or curved movements but rather guided arm movements
- No prolonged stretching exercises of the shoulder girdle
- Beware of puncture pressure in the breast area
- Women with manifested arm lymphedema should participate with compression stocking
- Irradiated skin area should not be subjected to any additional mechanical stress
- Possibly: Water aerobics under water surface



Pict. 44: Scar after mastectomy

Relevant points

Important information for trainers

- Time and course of the disease
- Classification of the tumor
- Possible metastasis
- Previous therapies
- List of concomitant diseases that are important for the practice of sports:

Metabolic diseases, such as gout or diabetes

Cardiovascular diseases such as pathological blood pressure, infarction, arrhythmia, ...

Orthopedic diseases such as arthrosis, disc damage, ...

Tumorous diseases such as bone metastases, implants, stomata, ...



Legal points

The trainer's duties include the knowledge about legal requirements. This serves for his/her own protection!

The following liability principles are eligible for Germany:

1. Duties mentioned in contracts between the trainer, the operator and participants
2. Liabilities towards third parties even without contract, that may augment or complement liabilities towards partners of the contract
3. Every trainer has to be aware that he/she is legally responsible for their acts and for their omissions, especially:
 - a.) Bodily harms und homicide offenses
 - b.) accusations of violations of sexual self determination



Legal points

- Conviction leads to further claims of the civil law
 - > Prejudice of criminal justice
- Civil law claims have an impact on all self-employed trainers
- Financial settlement
 - > in contrast to the criminal justice, partial guilt and contributory negligence of the victim are possible

Statutory basis of the liability

- Other claims may also be applicable, e.g. employer health insurances, employer's liability insurance association, pension insurance, ...
- Financial damages will often be paid by the indemnity insurance of the operator, taking the trainer in regress

Legal points (German example)

Gefährdungseinschätzung

Für konkrete Haftung des Trainers muss eine Verletzung seiner Pflichten durch Tun oder Unterlassen vorliegen. Folgende Faktoren zu Gefährdungseinschätzung spielen eine Rolle:

1. **Einsichtsfähigkeit der Teilnehmer:** Ist der Teilnehmer in der Lage ist, die Situation und die Anweisungen des Trainers zu verstehen und umzusetzen.
2. **Modell des Wissensstärkeren:** der Trainer ist grundsätzlich viel besser als der Teilnehmer mit möglichen Konsequenzen der ausgeübten Tätigkeiten vertraut.
3. **Garantenstellung aus Vertrag:** der Trainer verantwortet gegenüber seinem „Kunden“ die konkrete Situation, in die er durch die jeweilige Übung gerät. Grundsatz „Du hast mich in Gefahr gebracht und holst mich hier auch wieder raus!“
4. **Praxis in den vergleichbaren Geschäftskreisen:** es gelten die branchenüblichen Sicherheitsstandards und Normen in ihrer jeweils aktuellen Ausprägung, zwischenzeitlich veraltete Sicherheitsstandards sind nicht zulässig.

Legal points (German example)

Es ergeben sich Pflichten, deren Nichtbeachtung Haftung verursachen kann:

1. **Informationspflicht:** Der Teilnehmer ist umfassend über die Anlage / Geländebesonderheiten und die Verhaltensregeln zu informieren.
2. **Empfehlungspflicht:** Dem Teilnehmer – auch ungefragt – ist eine für ihn geeignete Übung zu empfehlen, bzw. von ungeeigneten Übungen abzuraten. Hierzu zählt auch die Entscheidung über die generelle Teilnahmefähigkeit.
3. **Instruktionspflicht:** Der Teilnehmer ist in die (Trainings-) Abläufe und Sicherheitsvorschriften vollständig zu unterweisen. Der Lernerfolg ist zu kontrollieren.
4. **Aufsichtspflicht:** Der Trainer hat die Teilnehmer ihrem Alter und Ihrer Einsichtsfähigkeit entsprechend zu beaufsichtigen und selber über die notwendige Intensität seiner Eingriffsmöglichkeit zu entscheiden. Die Aufsichtspflicht endet nicht automatisch mit dem 18. Lebensjahr!
5. **Interventionspflicht:** Beobachtet der Trainer eine Situation, von der er wissen muss (Ausbildung, Erfahrung), dass sie eine erhöhte Gefährdung bedeutet, muss er handeln. Ggf. die Aktivität auch ganz abbrechen, auch wenn dies den Interessen von Veranstalter, Betreiber, Auftraggeber und / oder Teilnehmer zuwider läuft.
6. **Nebenpflichten durch eigene Erkenntnisse:** Sind dem Trainer Umstände bekannt, dass es im Bereich der Anlage oder aufgrund organisatorischer Mängel zu Schäden kommen kann, hat er darauf hin zu weisen. Auch wenn es sich um originäre Risiken des Betreibers und des Veranstalters handelt

Legal points (German example)

Der Verschuldensgrad

Der Verschuldensgrad ist für die Bewertung des tatsächlichen Mitverschuldens und damit der Schadenssumme maßgeblich:

- 1. Fahrlässigkeit:** Die erforderliche Sorgfalt wird durch die „übliche“ Sorgfalt ersetzt (Beispiel Straßenverkehr: in der geschlossenen Ortschaft mit 60 km/h statt der erlaubten 50 km/h fahren)
-> Haftungsbeschränkungen aus den AGB des Veranstalters.
- 2. Grobe Fahrlässigkeit:** Die erforderliche Sorgfalt wird in erheblichen Maße nicht berücksichtigt (Beispiel Straßenverkehr: in der geschlossenen Ortschaft mit 100 km/h statt der erlaubten 50 km/h fahren)
-> Haftungsbeschränkungen aus den AGB des Veranstalters sind unwirksam
-> gerade für gut ausgebildete Trainer ist der Vorwurf der groben Fahrlässigkeit sehr schnell erreicht.
- 3. Vorsatz:** Neben dem direkten Vorsatz (mit Wissen und/oder Wollen etwas Tun), ist der bedingte Vorsatz in der Praxis sehr schnell erreicht (es nicht gewusst und gewollt haben, aber billigend in Kauf nehmen). Hierzu zählen alle Situationen, in denen der Trainer das „Unglück“ hat kommen sehen und nicht aktiv wurde.

Legal points (English example)

- I hereby assume all of the risks of participating in the group training, including by way of example and not limitation, any risks that may arise from negligence or carelessness on the part of the persons or entities being released, from dangerous or defective equipment or property owned, maintained or controlled by them, or because of their possible liability without fault.
- I certify that I am physically fit and have not been advised to not participate by a qualified medical professional.
- I certify that there are no health-related reasons or problems which preclude my participation in this group training.
- I acknowledge that this Release of Liability Form will be used by the organizers of the group training in which I may participate and that it will govern my actions and responsibilities.
- In consideration of my application and permitting me to participate in this group training,



Legal points (English example)

– I hereby take action for myself, my executors, administrators, heirs, next of kin, successors, and assigns as follows:

(A) I, RELEASE, AND DISCHARGE from any and all liability, including but not limited to, liability arising from the negligence or fault of the entities or persons released, for my death, disability, personal injury, property damage, property theft, or actions of any kind which may hereafter occur to me including my traveling to and from this group training.

(B) I INDEMNIFY, HOLD HARMLESS, AND PROMISE NOT TO SUE the entities or persons mentioned in this paragraph from any and all liabilities or claims made as a result of participation in this group training, whether caused by negligence or otherwise. I acknowledge that this training group may carry with it the potential for death, serious injury, and personal loss. The risks may include, but are not limited to, those caused by terrain, facilities, temperature, weather, condition of participants, equipment, vehicular traffic, actions of other people including, but not limited to, participants, volunteers, spectators, coaches, and lack of hydration.

I CERTIFY THAT I HAVE READ THIS DOCUMENT, AND I FULLY UNDERSTAND ITS CONTENT. I AM AWARE THAT THIS IS A RELEASE OF LIABILITY AND A CONTRACT AND I SIGN IT ON MY OWN FREE WILL.



Training schedule

Checklist

1. Is there a timeline for the schedule?
(Introduction, main part and ending as parts of the training)
2. Did I point out transfer possibilities in daily life, e.g. possibilities of training the lesson's content in daily life? This is a crucial part to secure long-term success.
3. Is it obvious how the content is presented to the participants?
Is the methodological and didactic procedure clear?
(presentation, limitation of exercises, ...)
4. If the target group are children: Are the parents included in some course units (like first and last lessons)
5. Make sure to make schedules in regards to the different days.
6. For the lesson's main part: Are there exemplary exercises given in the schedule? Are the goals clear, so that a proxy can do the lesson for me?

Training schedule

Training-principles for conceptualizing a schedule

- Principle of development and health promotion
- Principle of the right combination of training parameters
- Principle of progressive workload
- Principle of the optimal ratio of training and regeneration
- Principle of periodization/cyclisation of the training
- Principle of repetition and sustainability
- Principle of the variety of the training



Pict. 45: Full body workout

Planning your training

General strength training with cancer patients

- Training of big muscle groups
- More repetitions in the beginning with only little intensity
-> then steady progression
- Caution: Keep the therapy and the individual's limitations and impairments in mind, e.g. CAVE and its contraindications
- Oncological strength training: methodological procedure „FITT“ (frequency, intensity, time, type)
- According to current research: high intensity training is more effective! -> even in the context of fatigue
- Jump-training leads to more positive effects on bone density than stretching (but attention: this has only been tested in studies and not in daily life)
- Tip: It can be helpful to check the perceived rate of exertion with the help of the Borg-scale. In terms of strength training values should range from 14-16!

Planning your training

Endurance training with cancer patients

1. Weak or untrained individuals:

- Intermittent training should be done in the beginning
- Alternating between running and pausing:
e.g. rhythms of 2-2 minutes rhythm or 3-1 minutes.
- Slowly increase the phases of running and reduce the pauses until continuous training is possible

2. Intermediates and trained individuals:

- Method of continuous training
- Continuous training is suitable as a long-term training method
- Long session of e.g. 30-60 minutes with moderate intensity (Borg 13-14)
- Shorter session of 10-30 minutes with higher intensity (Borg 15)

3. Advanced/motivated for doing high intensities:

- extensive interval training
- To have fast improvements of the endurance performance use alternating phases of high and low intensity.
- Common rhythm would be 4 minutes each.

Planning your training

Attention:

- Formulas to calculate heart rate are not always recommendable because the heart rate might be influenced by certain therapies or medication
- Really high intensities are not recommended. Those intensities require experience and a healthy cardiovascular system



Planning your training

Recommendations for sensomotoric training

A common side effect of chemotherapy are polyneuropathies. A consistent and effective therapeutic concept does not exist far. A sensomotoric training can help to mitigate the symptoms.

| Content | Duration |
|------------------------------------|-----------------|
| Duration of training program | > 4 weeks |
| Frequency | 2 – 6 x / week |
| Duration of training session | 6 – 30 minutes |
| Duration of exercise | 20 seconds |
| Rest between exercises | 40 seconds |
| Number of repetitions per exercise | 3 |
| Number of sets | 3 – 8 |
| Rest between sets | 1 – 3 minutes |

Planning your training

Coordination training with cancer patients

- Valuable for the avoidance of falls and for polyneuropathy
- Large variety
- Fast learning success combined with motivational characteristics of the exercises
- Movements become more economic and more efficient
- Improved body awareness
- Improved posture



Restrictions and side effects

| Restrictions and side effects | Consequence |
|---|---|
| Restricted mobility as a result of surgery (e.g. shoulder girdle and pectoralis from breast cancer) | Mobility and stretching exercises |
| Decreased ability to focus, impaired memory function (dementia) | Simple and clear structure, stick to what is necessary |
| Stomata/Ports (colon cancer) | Don't put pressure on it (lying, contact and ball sports) |
| Risk of bone fractures (osteoporosis, bone metastases) | Strength training |
| Therapy-caused muscle pain | |
| Nausea, constipation, diarrhea | Enough (drink)breaks , knowledge about the localities (toilets) |
| General tiredness, fatigue | Circulation stimulating exercises |
| (Poly-)neuropathy | Sensomotoric and proprioceptive training, barefoot training |
| Edema | Activation of the muscular pump, stimulation of the lymphatic system, comfortable clothes |
| Incontinence (prostate cancer) | Training of the the pelvic floor in combination with breathing exercises |
| Affected heart | Check-up with a cardiologist |
| Disorders of sensations: optic, acoustic, balance | Coordinative and awareness exercises |
| Skin irritations, rashes (hand- or feet-syndrome) | Adequate clothes and sun protection |
| Body composition (over- versus underweight, ratio between body fat and musculature) | Endurance training, strength training and adequate diet |

General advices

| Dos | Don'ts |
|--|--|
| Motivate your participants and give them a feeling of safety. Engage them to find their limits, to go to their limits and maybe overcome them. Have confidence in your participants! | Avoid dictating. Your participants are mature individuals |
| Support the awareness for the participant's perception of intensity (autonomous breaks, learning how to interpret body-signs). | Don't provoke blind ambition. Do not let anyone train into any pain. |
| Offer variations of the exercises (regressions, progression), make your sessions flexible and be flexible yourself! | Are not afraid of the situation and be ready to learn with and from your participants. |
| Support team spirit and incorporate partner exercises ☒ it is about being a community | No teacher oriented lessons – “look I can do so much” ... |
| Know your own limits and refer the participants to experts if necessary | |
| Plan time for questions and feedback before and after the actual session. This way you can build trust faster. | |
| Be observant for changes in behaviour of your participants. | |