

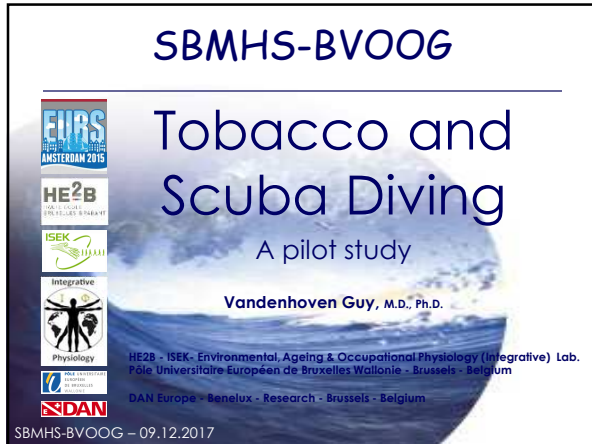
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Tobacco and Scuba Diving
A pilot study

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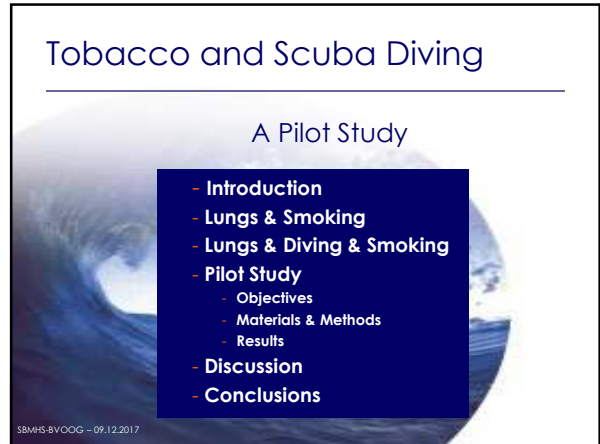


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Tobacco and Scuba Diving

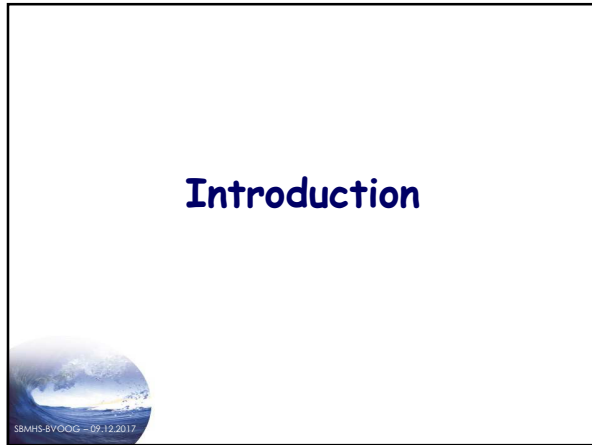
A Pilot Study

- Introduction
- Lungs & Smoking
- Lungs & Diving & Smoking
- Pilot Study
 - Objectives
 - Materials & Methods
 - Results
- Discussion
- Conclusions



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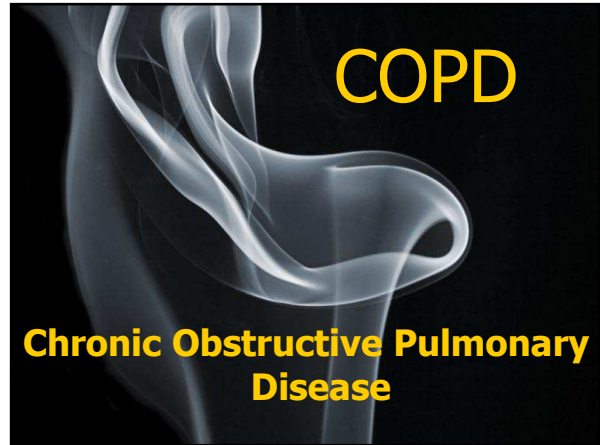
Introduction




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COPD

Chronic Obstructive Pulmonary Disease



1 = 5

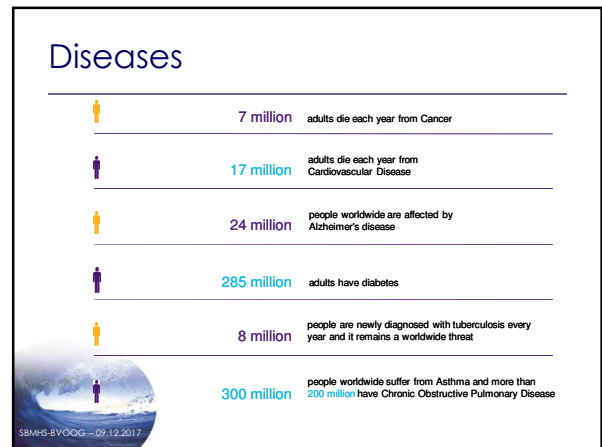
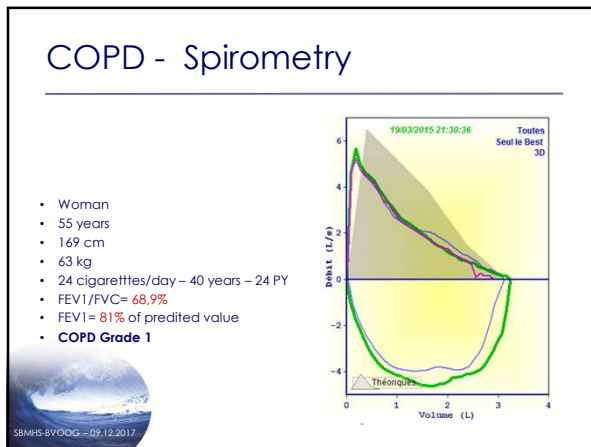
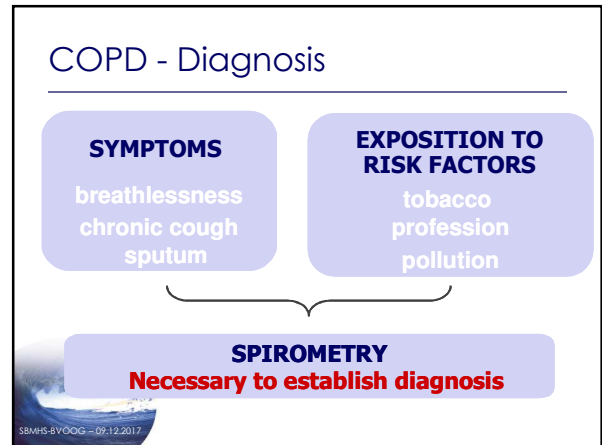
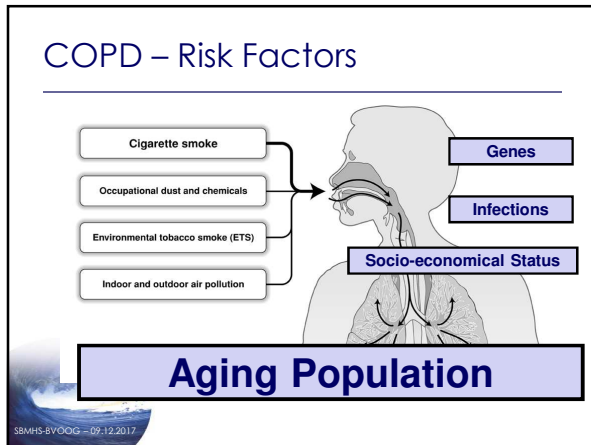
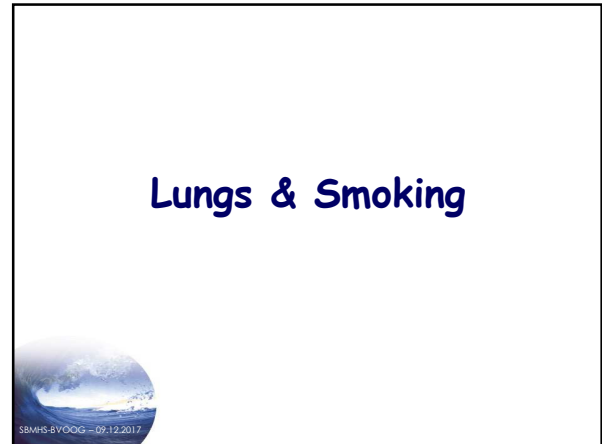


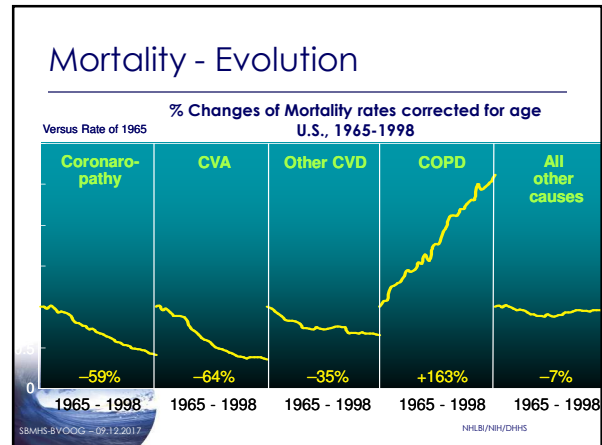
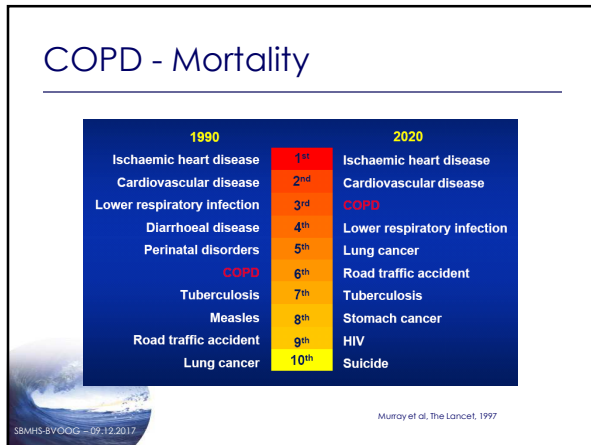
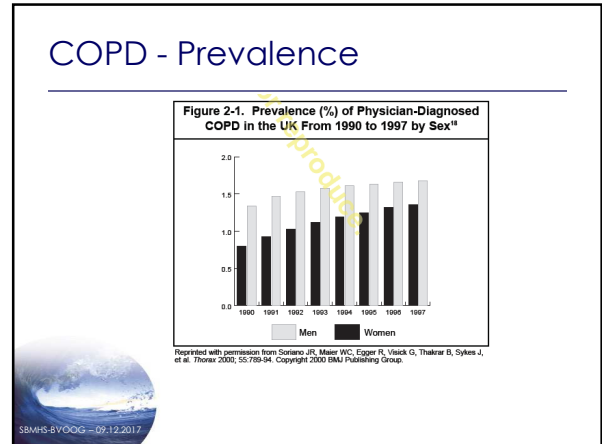
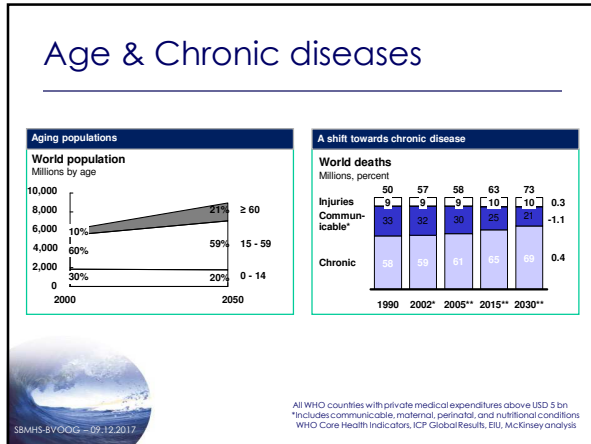
1 = 5

1 cigaret,
5 minutes of live
gone in smoke.

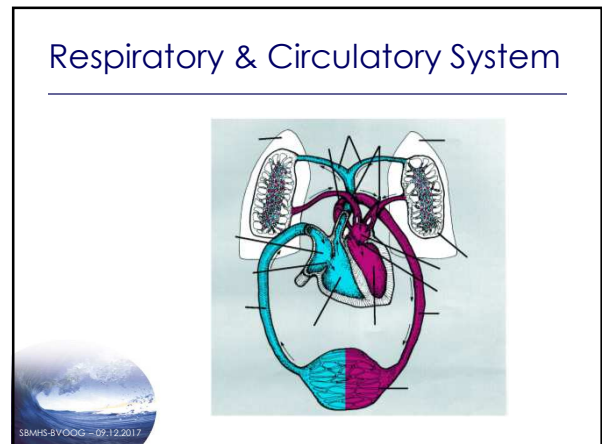
Source : ISP study

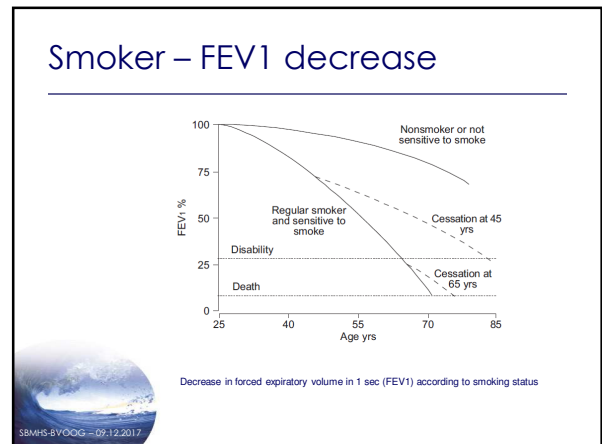
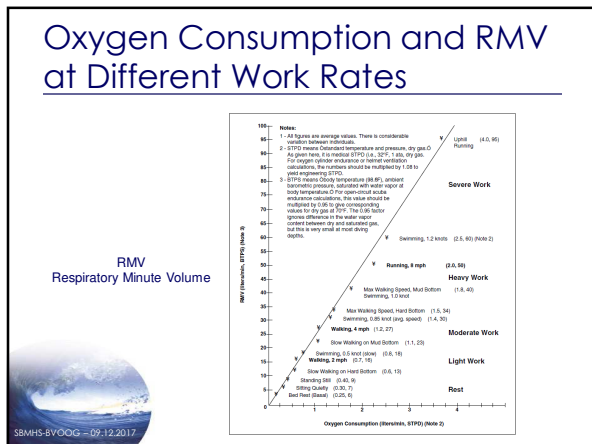
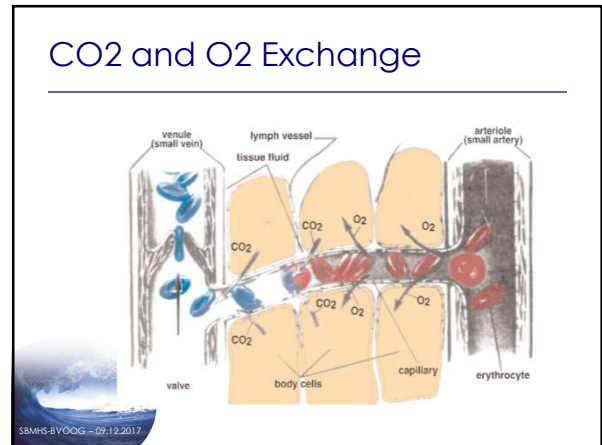
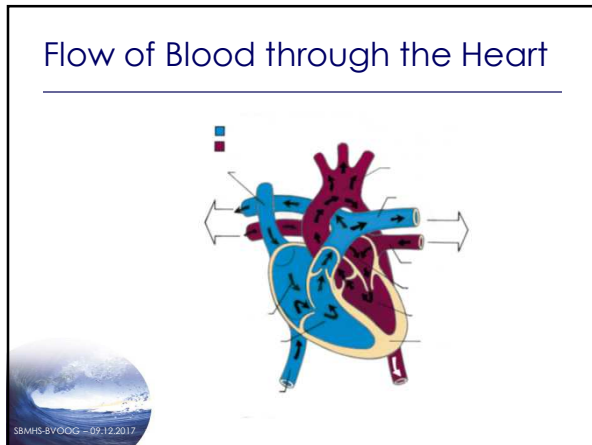
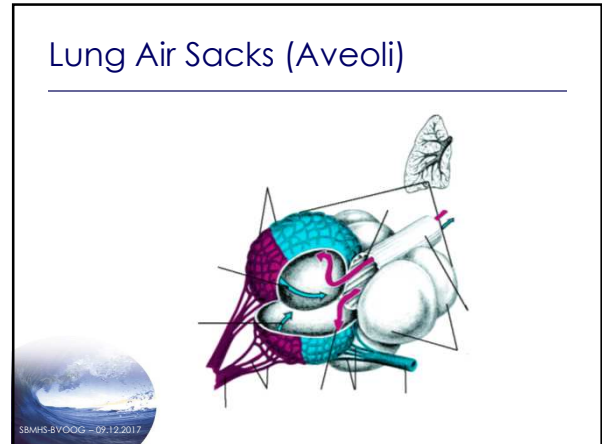
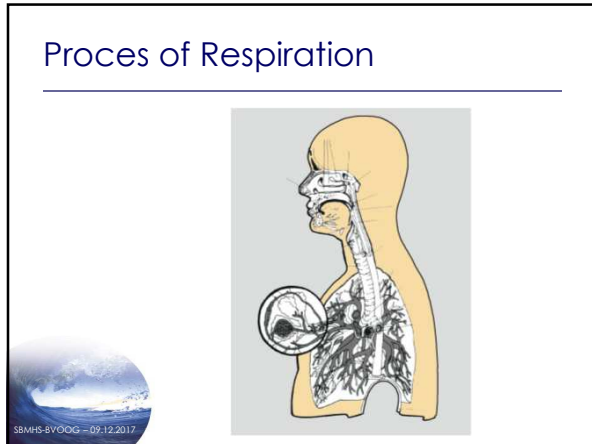






Lungs & Smoking & Diving





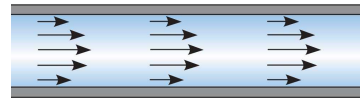
What are the risks ?

- The **lung** has a **tremendous exchange surface**.
(180 m² - tennis court = 195,63 m²)
- **Most substances** contained in cigarets will **pass through** this exchange surface no matter the type of tobacco.
- Tobacco smoke contains **gas, vapour** and **particles** transiting the respiratory system according to their size.
- **Four agents** will act in **first line** :
Nicotine Carbon monoxide (CO) Tar Irritants

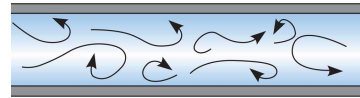
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Flow – Laminar versus Turbulent

Laminar Flow



Turbulent Flow



Flow – Laminar versus Turbulent

- **Airways resistance** is affected by changes in **gas density**.
- **Resistance** is defined as the **pressure decrease** across a tube divided by **flow**.
- In **laminar flow** : flow is **largely independent** of the **density of the gas**.
- In **turbulent flow** : flow is **inversely related** to **gas density**.

Flow – Laminar versus Turbulent

- **Flow** within the **lungs** and **airways** is **largely laminar**.
- **Turbulent flow** occurs widely in the **large airways** at each division of the bronchial tree, particularly during **rapid breathing** when flow rates are much higher.

Cigarette smoke

- Each **cm³** : > **5 million particles** including **dangerous chemicals** on the Environmental Protection Agency's list of illegal to dispose in the **environment**.
- Gaseous and particular phases contains **4700 compounds** including **43 known carcinogens**.
- Dose of **carbon monoxide** a smoker receives from smoking is **toxic** .

Carbon monoxide

- Binds with **hemoglobin** to make **carboxyhemoglobin** : CO binds 200 to 300 times more readily than O₂ → hypoxia (oxygen deficiency)
- Binds with **myoglobin** : oxygen-transporting and storage protein of **muscle**
- Binds to **cellular enzyme cytochrome oxidase** : transfer of O₂ from blood to inside of **cells**
- Blocks hemoglobin from **removing CO₂** → **carbon dioxide toxicity** → **decompression sickness**.

Carboxyhemoglobin relative to CO Exposure

Continuous Exposure Level of CO	HbCO in Blood
50 ppm	8.4 %
40 ppm	6.7 %
30 ppm	5.0 %
20 ppm	3.3 %
10 ppm	1.7 %
-	0.5 % (non-smoker)



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Carboxyhemoglobin as a Function of Smoking

Smoking Habits	Median HbCO Level, %	Expired CO, ppm
Light smoker (less than 1/2 pack/day)	3.8	17.1
Moderate smoker (more than 1/2 pack/day and less than 2 packs/day)	5.9	27.5
Heavy smoker (2 packs or more/day)	6.9	32.4



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Smoker

- **Carbon monoxide concentration** of inhaled from smoking **one cigarette** averages **400 to 500 ppm** producing up to **10% of carboxyhemoglobin**.
- **Oxygen-carrying capacity of blood** of smoker can be **reduced** by as much as **10%**.
- **Carboxyhemoglobin level of light smoker diving 8 hours after the last cigarette is 0,95%** (twice that of non-smoker - 0,50%)
- **Carboxyhemoglobin level of passive smoker** (non-smoker exposed to smoke) can rise to **5%**.
- A **heavy smoker** takes approximately **8 hours** to **eliminate 75% of carbon monoxide** inhaled



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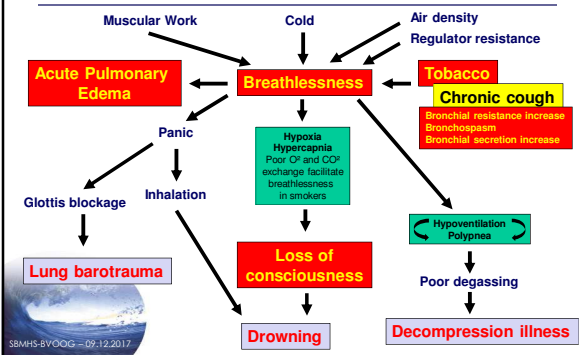
What are the risks ?

- Causes of diving accidents are multifactorial : **Physical – Physiological – Environmental**
- Tobacco can be on the origine of several diving accidents but **prove of causality** remains **difficult**
- The action of tobacco on our organism is mainly **physiological**
- Incidents / accidents arising from smoking are due to :
 - effects of **inhalation of smoke close to imerging**
 - additional risks of **cardiovascular** and **pulmonary pathology** caused by long-term smoking



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Breathlessness

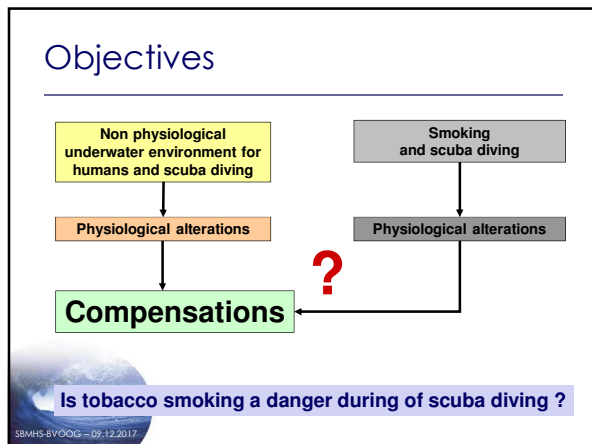


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Pilot Study

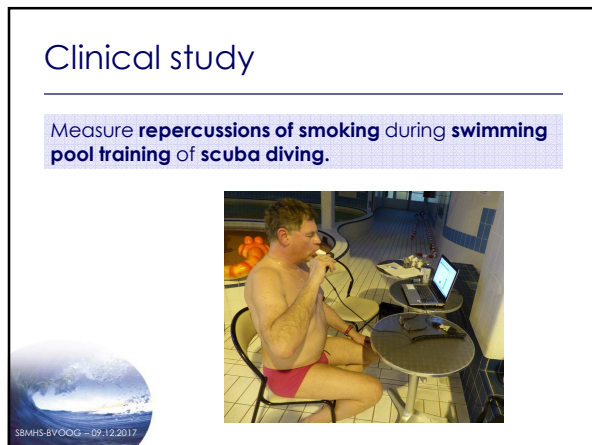


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Epidemiological study

Quantify **smoking rate** in **scuba diving world**.



- ### Study rationale
- To collect **data** regarding **safety** of **smoking divers**
 - To elaborate **arguments** to **inform** and **warn divers** on **smoking**

Materials & Methods



Material-Methods : Questionnaire

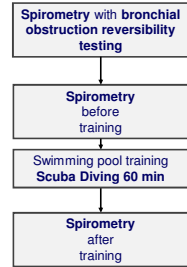
Questionnaire available for 226 **membres** of **diving club** :

- **On-line** version
- **Paper** version available during training sessions
- **Period** from 1st december 2014 till 4th april 2015
- **Reply duration** of questionnaire
 - ± 5 minutes for non-smokers
 - ± 10 minutes for smokers

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Material-Methods : Spirometry

- **Groupe A** : divers - **non exposed** to tobacco
- **Groupe B** : divers - **smokers and ex-smokers** (smoking ≥10 years)



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Material-Methods : Spirometry

Measured variables : Forced expiratory flows

- FEV1 → **Forced Expiratory Volume 1 Sec.**
- FEV1/FVC → **Tiffeneau Index**
- PEF → **Global indicator of obstruction**
- FEF2575 } → **Small and medium airways**
- FEF25 }
- FEF50 }
- FEF75 }

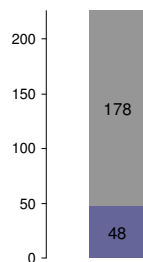
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Results

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Results : Questionnaire

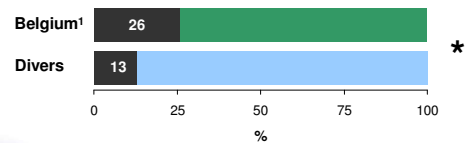
- Members – total : 226
- Members – replied : 48
- Reply rate : **21%**



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Results : Questionnaire

Proportion of smokers :



¹ Rapport adressé à la Fondation contre le Cancer, Comportement des fumeurs en Belgique 2014. © GIK Belgium, August 2014

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Results : Questionnaire

As a comparaison :

	Belgium ¹	Divers
Spontaneous advice to stop smoking by physician	37%	67%
Intention to stop smoking	61%	83%

¹ Rapport adressé à la Fondation contre le Cancer. Comportement des fumeurs en Belgique 2014. © GIF Belgium, August 2014

Results : Questionnaire

- Mean smoking duration :**
 - Smokers : **20 ± 14 years** with **14 ± 8 cigarets/day**
 - Ex-smokers : **17 ± 9 years**
- Habits :**
 - 64%** smokers **within hour of diving**

Results : Questionnaire

- Diving accidents :**
 - 13% of all divers
 - No statistical differences between non-smokers, passif smokers, ex-smokers and smokers
- Breathlessness (divers without effort) :**
 - 17% of all divers

Results : Questionnaire

Breathlessness :

Group	Mean Rang
1 (n= 20)	21
2 (n= 5)	26
3 (n= 17)	25
4 (n= 6)	36

A higher ranking reflected a more severe breathlessness :

- 1 => **non-exposed**
- 2 => **passif smokers**
- 3 => **ex-smokers**
- 4 => **smokers**

Results : Questionnaire

Breathlessness :

Comparison of groups	Significance
1 et 2	p= 0,046
1 et 3	p= 0,053
1 et 4	p< 0,001
2 et 3	p= 0,771
2 et 4	p= 0,314
3 et 4	p= 0,027

All groups exposed to tobacco were significantly more subject to breathlessness


Ex-smokers were significantly less breathlessness than active smokers

Results : Spirometry

Differences before/after training :

Significant decrease of all expiratory flows


	n= 10	Difference Mean pre - post	Sig. p=
FEV1/FVC pre - FEV1/FVC post (%)		3,06 ±4,38	0,054
FEV1 pre - FEV1 post (L/s)		0,14 ±0,10	0,002
PEF pre - PEF post (L/s)		0,65 ±0,46	0,002
FEF25 pre - FEF25 post (L/s)		0,40 ±0,40	0,010
FEF25 pre - FEF25 post (L/s)		0,52 ±0,55	0,015
FEF50 pre - FEF50 post (L/s)		0,46 ±0,44	0,009
FEF75 pre - FEF75 post (L/s)		0,21 ±0,26	0,029





Results : Spirometry

	Differences Mean pre - post		Significance
	A (n= 5)	B (n= 5)	
FEV1/FVC (%)	1,68 ±1,23	4,44 ±6,04	0,35
FEV1 (L/s)	0,18 ±0,13	0,09 ±0,03	0,19
PEF (L/s)	0,85 ±0,42	0,45 ±0,45	0,18
FEF2575 (L/s)	0,34 ±0,24	0,47 ±0,53	0,65
FEF25 (L/s)	0,83 ±0,62	0,20 ±0,20	0,06
FEF50 (L/s)	0,41 ±0,35	0,51 ±0,56	0,74
FEF75 (L/s)	0,10 ±0,17	0,32 ±0,30	0,18

Ex-smokers + Smokers (B) versus non smokers (A) :
No statistical differences





Discussion

Discussion

YES tobacco can be a risk factor for diving :



- **Active smokers** in the diving population but more awareness of the harmful impact of tobacco and thus less smokers in divers versus a general population.
- **Breathlessness** may induce more severe diving accidents and is an important safety issue for smoking divers. Moreover stop smoking can decrease breathlessness in ex-smokers.

Discussion

NEVERTHELESS


- tobacco seems not to impact more **respiratory performance** during swimming pool diving training. Swimming pool sessions led to a small asymptomatic, significant decrease in spirometric values without difference between smokers and non-smokers and which still stayed within normal range.
- tobacco seems not to impact **safety** of diving in this epidemiological and clinical study.


Discussion


BUT

- divers **sample** is small (with mainly ex-smokers versus active smokers)
- and
- **diving accidents** are rare.



Conclusions






Conclusions

- **Inform** about **breathlessness** as an important safety issue to motivate smoking divers to avoid smoking during a diving day (extra CO load) and to stop smoking.
- **Measure lung function** in passive, active and ex-smokers to detect BPCO and to prevent diving accidents.
- **Plan an open water study** investigating lung function and bubble detection in a greater population of smoking versus non-smoking divers.

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Conclusions

Stop smoking 20 cigarettes per day* is

- After 4 days : 1 Nemo 33 dive (26,00 €)
- After 1 week : 1 Mares diving mask (45,50 €)
- After 1 month : 1 Aqualung diving suite 5 mm (201,50 €)
- After 1 trimester : 1 Galileo Sol dive computer (604,50 €)
- After 1 semester : 1 Egypt diving trip (1.209,00 €)
- After 1 year : 1 Maldives cruise diving (2418,00 €)

* Price - Marlboro Red - 20 cigarettes - 6,50 € - Belgium - 09.12.2017

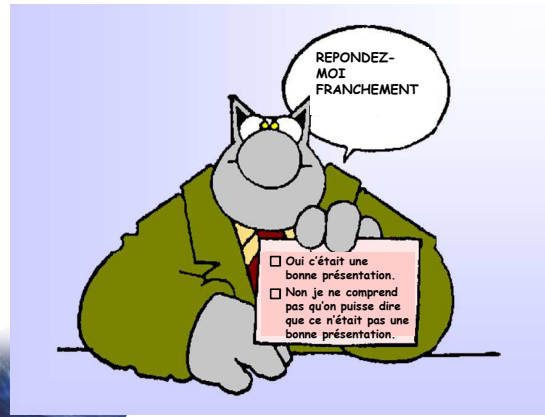
Tobacco and Scuba Diving

Half of what we taught you is wrong.

Unfortunately, we don't know which half.

Medical School Professor

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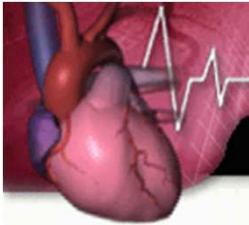
REPONDEZ-MOI FRANCHEMENT

Oui c'était une bonne présentation.

Non je ne comprend pas qu'on puisse dire que ce n'était pas une bonne présentation.

Tobacco and Scuba Diving

Questions ?



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