# THE SCIENCE-BASED FITNESS PROGRAM FOR OPTIMAL HEALTH AND BODY COMPOSITION IN LESS THAN 1 HOUR A WEEK

FINAL THESIS PhD Physical Medicine

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### 1: Why We Need to Exercise

Exercise is an absolute necessity if you want to optimize your heath as a human being. since There is a linear relationship between physical activity and health status and as a general rule, increases in physical activity and fitness result in additional improvements in health status. According to the World Health Organization (WHO) exercise contributes to preventing physical diseases such as cardiovascular diseases, cancer, and diabetes. Exercise also has mental and emotional benefits, as it reduces the symptoms of depression, anxiety, and enhances thinking, learning, and judgment skills.<sup>1</sup>

The opposite is proven as well, Lack of exercise is a major cause of chronic diseases like Accelerated biological aging/premature death, low cardiorespiratory fitness (VO2max), sarcopenia (muscle loss), metabolic syndrome, obesity, insulin resistance, prediabetes, type 2 diabetes, non-alcoholic fatty liver disease, coronary heart disease, peripheral artery disease, hypertension, stroke, congestive heart failure, endothelial dysfunction, arterial dyslipidemia, hemostasis, deep vein thrombosis, cognitive dysfunction, depression and anxiety, osteoporosis, osteoarthritis, balance, bone fracture/falls, rheumatoid arthritis, colon cancer, breast cancer, endometrial cancer, gestational diabetes, preeclampsia, polycystic ovary syndrome, erectile dysfunction, pain, diverticulitis, constipation, and gallbladder diseases

Insufficient physical activity is a leading risk factor for non-communicable diseases, and has a negative effect on mental health and quality of life. In a recent study from the World Health Organization, about 27.5% of the population in 2016 was recognized as sedentary.<sup>2</sup>

Another study shows that worldwide, 31.1% of adults are physically inactive, with proportions ranging from 17% in southeast Asia to about 43% in the Americas and the eastern Mediterranean.<sup>3</sup> Tendency for dose-response between higher physical activity level and lower mortality in Swedish monozygotic twins.<sup>4</sup>

<sup>&</sup>lt;sup>1</sup> <u>https://pubmed.ncbi.nlm.nih.gov/26319905/</u>

<sup>&</sup>lt;sup>2</sup> https://pubmed.ncbi.nlm.nih.gov/30193830/

<sup>&</sup>lt;sup>3</sup> https://pubmed.ncbi.nlm.nih.gov/22818937/

<sup>&</sup>lt;sup>4</sup> <u>https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4241367/</u>

Sex	Physical activity level	All-cause mortality		Cardiovascular mortality	
		Hazard ratio	95% confidence intervals	Hazard ratio	95% confidence intervals
Men	Low	1		1	
	Moderate	0.84	0.72, 0.98	0.86	0.68, 1.08
	High	0.64	0.50, 0.83	0.55	0.36, 085
Women	Low	1		1	
	Moderate	0.82	0.70, 0.96	0.85	0.64, 1.13
	High	0.75	0.50, 1.14	0.34	0.1,0.95

In short, to be a wholesome and healthy human, exercise is a must. However, globally, 1 in 4 adults do not meet the global recommended levels of physical activity. In fact, data from the WHO has shown that over 80% of the world's adolescent population is insufficiently physically active, and up to 5 million deaths a year could be averted if everyone was more active.

But like most things, it's easier said than done. We've been told that exercising takes up a lot of time – and we have to spend hours and hours at the gym if we want to stay fit and healthy. When the majority of people hear this, being healthy is like climbing Mt. Everest. It's not a sustainable solution because most people have to juggle that between working a full-time job, family, and other responsibilities. It's just not convenient enough, so when people have to choose, they choose life over exercise.

Most of the benefits of exercise seem to come from improvements in body composition, overall fitness and metabolic health, not just weight loss. To be more specific, here are some physical and emotional benefits that exercise can bring.

#### **Physical benefits**

- Overall cardiorespiratory fitness in the prevention and treatment of cardiovascular disease<sup>5</sup>
- Stimulates certain hormones
- Builds aerobic power
- Reduces blood pressure
- Lowers Type 2 diabetes risk
- Maintains immune functioning
- Reduces body fat
- Maintains strong bones and muscles<sup>6</sup>
- Improves breathing
- Induces quality sleep at night
- Reduces risk of diabetes type 2<sup>7</sup>
- Reduces obesity protective against stomach cancer risk<sup>8</sup>
- Reduces potential pancreatic cancer risk reduction<sup>9</sup>
- Risk reduction in various cancer types<sup>10</sup>
- Longevity and health-span<sup>11</sup>

<sup>&</sup>lt;sup>5</sup> Cardiovascular benefits: <u>https://pubmed.ncbi.nlm.nih.gov/26139859/</u>

<sup>&</sup>lt;sup>6</sup> Prevention and treatment of low bone mass: <u>https://pubmed.ncbi.nlm.nih.gov/24645301/</u>

<sup>&</sup>lt;sup>7</sup> Reduces risk of diabetes type 2: <u>https://pubmed.ncbi.nlm.nih.gov/25226803/</u>

<sup>&</sup>lt;sup>8</sup> Reduces obesity protective against stomach cancer risk: <u>https://pubmed.ncbi.nlm.nih.gov/24434186/</u>

<sup>&</sup>lt;sup>9</sup> Reduces potential pancreatic cancer risk reduction: https://pubmed.ncbi.nlm.nih.gov/25773752/

<sup>&</sup>lt;sup>10</sup> Risk reduction in various cancer types: <u>https://pubmed.ncbi.nlm.nih.gov/19107434/</u>

<sup>&</sup>lt;sup>11</sup> Longevity and health-span: <u>https://pubmed.ncbi.nlm.nih.gov/29293447/</u>

#### **Emotional & mental benefits**

- Improves mood<sup>12</sup>
- Lowers anxiety
- Feels like fun
- Reduces absenteeism
- Boost memory
- Lowers dementia risk

#### How to measure our fitness level for optimal health

There are many variables that we can use to measure our fitness level, and since this document focuses on simplicity, we will take the best independent predictor of all-cause mortality and cardiovascular, which is expressed as peak oxygen consumption (VO2peak). This is true even for people with various coronary risk factors and cardiovascular diseases.

VO2peak was strongly and inversely associated with CHD across the whole fitness continuum in a low-risk population sample. Increasing VO2peak may have substantial benefits in reducing the burden of CHD. In fact, the HUNT Fitness Study shows that peak oxygen uptake and incident coronary heart disease in a healthy population.<sup>13</sup>

VO<sub>2</sub> max refers to how much oxygen your body can absorb and use during exercise<sup>14</sup> Cardiorespiratory fitness, as measured by maximal oxygen uptake (VO2max), is related to functional capacity and human performance and has been shown to be a strong and independent predictor of all-cause and disease-specific mortality.

<sup>12</sup> https://pubmed.ncbi.nlm.nih.gov/24400778/

<sup>13</sup> https://pubmed.ncbi.nlm.nih.gov/30496487/

<sup>&</sup>lt;sup>14</sup> What is VO<sub>2</sub> max:

https://pubmed.ncbi.nlm.nih.gov/17218891/#:~:text=Introduction%3A%20Maximal%20oxygen%20uptake%20(.,limits %20of%20the%20cardiorespiratory%20system.&text=VO2%20during%20incremental%20exercise.)

#### Exercise vs physical activity: What's the difference?

**Physical Activity.** Movement of your body requires the work of your skeletal muscles. Your muscles must use energy to move your body. Any movement of your body requiring energy is considered physical activity.<sup>15</sup>

**Exercise.** Not all physical activity is exercise. Exercise is considered planned, structured and purposeful physical activity. The goal of exercise is to increase physical fitness.

<sup>&</sup>lt;sup>15</sup> Exercise vs. Physical Activity - Penn State College of Medicine Research: https://research.med.psu.edu/oncologynutrition-exercise/patient-guides/exercise-vs-activity/

## 2: How much exercise should we do?

The WHO<sup>16</sup>, AHA<sup>17</sup> and ADA<sup>18</sup> recommend at least 150 to 300 minutes of moderateintensity aerobic physical activity. The WHO acknowledges the correlation between intensity and results, so as an alternative to reduce the time spend and perform at least 75–150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate - and vigorous- intensity activity throughout the week. In addition to this and for further benefit, muscle-strengthening activities at moderate or greater intensity that involve all major muscle groups on 2 or more days a week, as these provide additional health benefits.

Despite being clear on all the benefits that exercise has, there's only 20% of the population that actually follows this recommendation. This means there's a majority of 80% that doesn't. In order to provide a science-based solution, we fist need to understand what are the barriers to physical activity.

Research shows that the most common internal barriers for middle-aged respondents were 'too tired' (48.3%), 'already active enough' (38.3%), 'do not know how to do it' (36.7%) and 'too lazy' (36.7%) when it comes to exercise.<sup>19</sup>

The Mayo Clinic Research points out even more barriers:

- I don't have enough time to exercise. Setting aside time to exercise can be a challenge.
- I think exercise is boring.
- I'm self-conscious about how I look.
- I'm too tired to exercise after work.
- I'm too lazy to exercise.

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<sup>&</sup>lt;sup>16</sup> https://www.who.int/news-room/fact-sheets/detail/physical-activity

<sup>&</sup>lt;sup>17</sup> <u>https://www.diabetes.org/healthy-living/fitness/weekly-exercise-targets</u>

https://www.ahajournals.org/doi/full/10.1161/CIRCOUTCOMES.118.005263#:~:text=For%20substantial%20health%2 0benefits%2C%20adults,moderate-%20and%20vigorous-intensity%20aerobic

https://pubmed.ncbi.nlm.nih.gov/24154584/#:~:text=The%20most%20common%20internal%20barriers,active%20enough%27%20(38.4%25)

- I'm not athletic.
- I've tried to exercise in the past and failed.
- I can't afford health club fees.

Understanding the underlaying causes of generalized lack of exercise will help us provide a science-based exercise protocol that facilitates to overcome the barriers expressed, but before that, we are going to bring some light to certain conventional wisdom related to exercise that and uncover the reality behind it

#### The no pain no gain paradigm (Myth 1)

The fitness industry has led us to believe that in order to achieve optimal fitness results we actually have to work out long hours at the gym and always pushing ourselves harder and harder, otherwise we are considered as lazy. Instead of motivating majority of the population, this actually discourages them to even start an exercise program since there's a perceived high amount of time and effort demands. But is it the longer and more intense the exercise the better or there is another way?

In order to answer this question, let's first look at what top endurance Olympic athletes in the world do. You probably believe that they work hard and intense consistently to achieve those results, but science proves this common believe wrong. In a research published in 2021<sup>20</sup>, where they were investigating the training characteristics of world-class long-distance cross-country skiers, their total training volume was divided as follows:

- Total endurance training: 92%
- Strength Training: 6%
- Speed Training: 2%

Being endurance athletes, makes sense that they spent most of their time doing endurance training, but the main question is: at what intensity were they training? The study showed that

<sup>&</sup>lt;sup>20</sup> The Training Characteristics of World-Class Male Long-Distance Cross-Country Skiers: <u>https://www.frontiersin.org/articles/10.3389/fspor.2021.641389/full#B12</u>

88.7% was Low Intensity Training (LIT), 6.4% Medium Intensity Training (MIT), and 4.8% Hight Intensity Training (HIT)

It's important to note that they are professional athletes and this is their full-time job. They exercise an average of 900 hours a year, which equals to around 3 hours a day, 6 days a week.

In another study published in 2019<sup>21</sup> where they analyzed the training intensity and load characteristics of professional cyclists using a 4-year retrospective analysis, their average heart rate for an entire year was 65%. To put this in perspective, it's an equivalent to a brisk walk for normal population, and proven to be a sufficient intensity to elicit a training HR in people with coronary disease.<sup>22</sup>

The main goal of this point is to understand that not even world class athletes follow the no pain no gain paradigm since vast majority of their exercise is perform at low intensity. Now, that this point is clear, and acknowledging that general population doesn't have 3 hours a day to exercise, we wonder if there's a way to have health improvements with dramatically less time invested.

#### Exercising to burn calories: Does it work? (Myth 2)

While doing exercise does burn more calories that not doing exercise, contrary to popular believe, it's NOT an efficient way. What I'm saying now sounds like it goes against conventional wisdom and may be shocking for mostly everyone. So, let's break it down.

For our example we will use 35-year-old men and women.

**A man weighing in at 80 kg and 180cm in height** can burn about 504kcal with a 60-minute jog (at an 8.34 min./km pace).<sup>23</sup> We need to keep in mind that our body consumes calories to keep sustain our life, that is called a Basal Metabolic Rate (BMR). For this man his BMR is 1755

<sup>&</sup>lt;sup>21</sup> Training Characteristics of Male and Female Professional Road Cyclists: A 4-Year Retrospective Analysis: <u>https://pubmed.ncbi.nlm.nih.gov/31722298/</u>

<sup>&</sup>lt;sup>22</sup> https://pubmed.ncbi.nlm.nih.gov/12426293/

<sup>23</sup> https://caloriesburnedhq.com/calories-burned-running/

kcal /day<sup>24</sup>, which means 73 kcal an hour. So, in reality thanks to the exercise alone we have burned 504-73= 431kcal.

A woman weighing in at 65kg and 165cm in height burns around 410kcal with a 60-minute jog (at an 8,34 min./km pace). Once again need to keep our BMR in mind. So, for this woman her BMR is 1345 kcal /day, which means 56 kcal, an hour. This means, in reality thanks to the exercise alone we have burned 410-56= 354kcal.

Now, let's put this into a real-life scenario. So, an average doughnut, 1 pizza slice or Snickers bar (58.7 gr) is 280kcal, and 1 bottle of vitamin water is 120 kcal. This means that the man in the example will need to jog for 39 minutes to burn off 1 slice of pizza or snickers bar, and 15 minutes to burn off the calories from the bottle of vitamin water. The woman in the example will need to jog for 47.5 minutes to burn that 1 slice of pizza or Snickers bar, and 20 minutes to burn off calories from the vitamin water.

And we aren't even counting that it's proven that the fitter we get, the less calories we burn, so overtime we will burn less calories with the same time of exercise.<sup>25 26</sup>

These are scary statistics. By sharing this, we aren't trying to discourage people from doing exercise. Instead, we want them to have a proper understanding, with real numbers about the science behind exercise since we have shown that exercising with the single objective of burning calories is not the most effective way to reduce calories. The best strategy is with proper nutrition.

<sup>&</sup>lt;sup>24</sup> BMR calculator: https://www.calculator.net/bmr-

calculator.html?ctype=metric&cage=35&csex=f&cheightfeet=&cheightinch=10&cpound=160&cheightmeter=165&ckg =65&cmop=1&coutunit=c&cformula=m&cfatpct=20&x=49&y=13 <sup>25</sup> https://mybestrong.com/wp-content/uploads/2019/02/Why-doing-more-exercise-wont-help-you-burn-more-calories-

<sup>-</sup>New-Scientist.pdf

<sup>&</sup>lt;sup>26</sup> https://pubmed.ncbi.nlm.nih.gov/12609816/

Now, that this is clear, we just have liberated ourselves from the "no pain no gain" and "the more the better" myth.

#### Instead of burning calories, the main objectives of doing exercising should be to:

- 1. Improve our vo2 max
- Conserve fat-free mass and resting energy expenditure following weight loss (Resistance training conserves fat-free mass and resting energy expenditure following weight loss)
- 3. Stimulate fat burning hormones, growth hormones, and catecholamines (adrenaline and noradrenaline)
- 4. Boost our metabolism (to increase muscles and the afterburn effect)

The **afterburn effect** describes the increased number of calories our body expends to recovery from a vigorous exercise activity. The term is "excess post-exercise oxygen consumption," or "EPOC," and it is influenced by the intensity of the exercise. The more intense the exercise, the higher the number of calories consumed in the afterburn.

#### 3: Two main types of exercise: Cardiovascular (endurance) and strength training

There are two main types of exercise that will help you stay healthy and burn fat: Cardiovascular "cardio" and strength training. Cardio exercises are also known as endurance or aerobic exercise. This type of exercise includes any activity that gets your blood pumping and large muscle groups working. It's also known as cardiovascular activity, which includes cycling, fast walking jogging, dancing, swimming to name a few. Essentially, what a cardio work out does is it gets your heart pumping and oxygenated blood flowing.

Cardio exercises have been categorized into three different intensities: Low (LIT), Medium (MIT) and High (HIT) intensity training. As stated by the WHO, the more vigorous the exercise, the less time we need, and this is proven by multitude of studies that have compared LIT, MIT, and HIT. Now let's define LIT, MIT and HIT

An exercise activity is considered low intensity when your heart rate (HR) goes from 50% to 70% HR max; medium intensity when HR goes from 70 to 80%; and HIT when the HR is above 80%.

Let's dive into the science behind HIT and the benefits compared to LIT/MIT. The following table shows a standard LIT/MIT exercise activity.



In general, 50 to 70 minutes are recommended to elicit health benefits. Exercising within this time range has also been proven to have a lot of therapeutic benefits. But since we know that the lack of time is the main barrier of exercising, LIT/MIT is not only time consuming, but is also less effective than HIT.

#### What is High Intensity Interval Training (HIIT)?

HIIT involves short bursts of intense exercise alternated with low-intensity recovery periods. Interestingly, it is perhaps the most time-efficient way to exercise. HIIT will ranges from 10 to 30 minutes in duration, and it's proven to produce health benefits similar to twice as much moderate-intensity exercise.



The idea is to vary the intensity of your workout. Go hard, relax, go hard, relax. The harder you go, the shorter the duration and the fewer intervals you need to achieve the same benefits of a much longer endurance-training workout.

Let's take a look at how a HIIT progresses and what it does to your body.

#### Here's what happens *during* a HIIT:

- The *rate* of fuel depletion is increasing dramatically. (The key to better results with less time investing.)
- More of the muscle is involved in, especially Type II muscle fibers. (Muscle fibers are generally grouped into two broad categories.)
- Bigger disturbance is created.

#### Here's what happens after HIIT:

• HIIT produces excess post-oxygen consumption (EPOC). This raises your resting metabolic rate for up to 48 hours after your training session. In other words, you're continuously burning fat even at rest.

#### The science behind HIIT

HIIT is by far the most efficient work out compared to MIT or LIT, making it extremely suitable for busy people who are often running on a tight schedule. Here are a few research comparing HIIT with MIT and LIT.

**Research 1.** A study published by the National Institute of fitness and sports in compared MIT vs HIIT in a 6-week training. The MIT group performed workouts for 60 minutes while the HIIT only did 4 minutes (both excluding warm up and cool down). The results revealed that the MIT group increased their VO2Max 10% and the HIIT group increased their VO2Max 15%

In other words, the HIIT group had a 50% improvement of Vo2 mac compared to MIT, while MIT required 15 times more (4 min, compared to 60).

**Research 2.** This research looked into doubling endurance capacity in 2 weeks and 15 minutes total of time under tension.<sup>27</sup> This study, published in the Journal of Applied Physiology concluded that short sprint interval training (approximately 15 min of intense exercise over 2

<sup>&</sup>lt;sup>27</sup> <u>https://pubmed.ncbi.nlm.nih.gov/15705728/</u>

weeks) increased muscle oxidative potential and doubled endurance capacity during intense aerobic cycling in recreationally active individuals.

Eight recreationally active subjects age 22 and 23 did 6 training session in a period of 2 weeks where they performed 6 training session consisted of 4 to 7 "all-out" 30-s exercise tests with 4 min of recovery. The results showed CS resting muscle glycogen content increased by 26% and cycle endurance capacity increased by an average of 100% while the control group consisting of another 8 young adults showed no change in performance when tested.

#### Research 3.28

In this study, twenty recreational exercisers of young adults of 23 (+-3) years old, were divided into two groups, with five men and five women in each group. This study lasted for 6 weeks.

Group 1 performed forty to sixty minutes of exercise per day. 5 days a week of steady cycling at an intensity of 65 percent of their maximal aerobic capacity, which is within the moderate range as recommended in the public health guidelines. The pace was enough to get their heart rate elevated and get them sweating. Their total workout time in per week was 5 hours.

Group 2 did a few warm up on the exercise bicycle, and then they performed 4 to 6 thirtysecond-long sprints with 4 and a half minutes rest in between for three days. The total workout time in a week was 60 to 90 minuets - from which 6 to 9 minutes was exercise time and the other 54 to 86 minutes were rest time between rounds.

The total weekly time spent working out was 3 times more for group, and the results showed that both groups have the same improvements for every fitness parameter:

- Equal aerobic fitness
- Equal increase in mitochondria
- Equal ability to burn fat during exercise

In essence, group 2 got the same results with one third of time invested and less than 10 minutes of effort each week.

<sup>&</sup>lt;sup>28</sup> <u>https://pubmed.ncbi.nlm.nih.gov/17991697/</u>

**Research 4.**<sup>29</sup> This research was a systematic review and meta-analysis of interval training versus moderate-intensity continuous training on body adiposity published by an official journal of the international association for the study of obesity that evaluated the efficacy of HIIT/SIT when directly compared with MICT for the modulation of body adiposity.

All the studies had a duration of a minimum of 4 weeks, they analyzed more than 6000 studies and included 312 relevant studies on the topic. The results concluded that both HIIT/SIT appears to provide similar benefits to MICT for body fat reduction while being HIIT/SIT significantly more time-efficient.

The research also points out that neither short-term HIIT/SIT and MICT produced clinically meaningful reductions in body fat. Which proves that exercise alone, it's not an efficient way to lose fat unless is combined with proper nutrition habits.

**Research 5.**<sup>30</sup> This analysis looked at the effects of high-intensity interval training vs. moderateintensity continuous training on body composition in overweight and obese adults. For this analysis, over 1334 studies were screened. Results showed that both HIIT and MICT elicited significant (p < 0.05) reductions in whole-body fat mass and waist circumference. There were no significant differences between HIIT and MICT for any body composition measure, but HIIT required ~40% less training time commitment. In other words, there were similar effectiveness across all body composition measures requiring 40% less workout time for HIIT compared to MICT.

#### How much HIIT is recommended?

Time and time again, studies have shown that HIIT is one of the most time-efficient exercise strategies out there that can improve our overall health and fitness.<sup>31</sup>

To achieve the effect of HIIT, as little as 3 HIIT sessions per week, involving  $\leq$ 10 min of intense exercise within a time commitment of  $\leq$ 30 min per session, including warm-up, recovery between intervals and cool down, is already sufficient. This amount of workout has been shown

<sup>&</sup>lt;sup>29</sup> https://pubmed.ncbi.nlm.nih.gov/28513103/

<sup>&</sup>lt;sup>30</sup> https://pubmed.ncbi.nlm.nih.gov/28401638/

<sup>&</sup>lt;sup>31</sup> <u>https://pubmed.ncbi.nlm.nih.gov/24552392/</u>

to improve aerobic capacity, skeletal muscle oxidative capacity, exercise tolerance and markers of disease risk after only a few weeks in both healthy individuals and people with cardiometabolic disorders. However, data also shows that 50 minutes of HIIT is a suggested maximum, cumulative time in order to prevent symptoms related to overtraining.<sup>32</sup>

HIIT burns more fat than static cardio training, it can also save you a tremendous amount of time. It's less investment for better results, who wouldn't want it? Especially when the main concern for most people is that exercising and going to the gym takes up too much time. With HIIT then, maybe you're really just looking for an excuse.

#### Strength training

Including strength (resistance) training won't turn you into a massive body builder. Especially for ladies who are concerned about looking "too muscular." That's not going to happen. The reason to include strength training and build toned muscles is because muscle is a metabolic active tissue – meaning it requires calories even when it's at rest.

Resistance training helps increase the strength, tone and amount of muscle you have. This is important for long-term health<sup>33</sup>, since inactive adults lose between 3–8% of their muscle mass per decade. Higher amounts of muscle also increase your metabolism, helping you burn more calories around the clock — even at rest.

Benefits of resistance training may include:

- Improved physical performance,
- Better movement control
- Functional independence
- Improved cognitive abilities,
- Increased self-esteem
- Prevention and management of type 2 diabetes
- Increased insulin sensitivity

<sup>&</sup>lt;sup>32</sup> <u>https://journals.lww.com/acsm-</u> msse/fulltext/2018/05001/exercise\_time\_and\_intensity\_\_the\_ideal\_ratio\_to.2157.aspx

<sup>33</sup> https://pubmed.ncbi.nlm.nih.gov/22777332/

- Enhanced cardiovascular health
- Reduced resting blood pressure
- Decreased low-density lipoprotein cholesterol and triglycerides, and increased highdensity lipoprotein cholesterol.
- Better bone development (with studies showing 1% to 3% increase in bone mineral density)
- Reduced low back pain
- Reduced discomfort associated with arthritis and fibromyalgia
- Reversed specific aging factors in skeletal muscle<sup>34</sup>

#### How much strength exercise do we need?

Conventional wisdom dictates that we should be in the gym for 1 hour and hit every muscle with multiple sets using different exercises. A standard routine will consist in 3 to 5 sets per exercise with 6 to 15 repetitions, and 2 to 5 different exercises per muscle group. This brings a total of 6 to +-20 total rounds per muscle.

#### The science behind strength training

The scientific literature suggests that 3 sets per muscle group a week is a sufficient stimulus to trigger the growth and strength mechanism of the body. Research also shows that even one single set per muscle group per week performed to the point of positive failure, will elicit improvement in muscle strength and body composition.

**Research 1.** Published in The Journal of Strength and Conditioning Research on The Effect of Weight Training Volume on Hormonal Output and Muscular Size and Function, 27 men with 1 to 4 years training experience were assigned to 3 different groups and workout 4 days a week for 10 weeks.

- Low Volume 3 sets per muscle group per week
- Medium Volume 6 sets per muscle group per week
- High Volume 12 sets per muscle group per week

<sup>34</sup> https://pubmed.ncbi.nlm.nih.gov/2243122/

The results showed that all 3 training volumes significantly (p < 0.05) increased muscle size, strength, and upper body power, with no significant between-group differences.

**Research 2.** Another study published by the Human Performance Laboratory<sup>35</sup> concluded that prevalent belief that at least 3 sets of each exercise are required to elicit optimal increases in strength and hypertrophy. However, most of the studies that reported the results of training with single versus multiple sets do not substantiate this tenet. In fact, the preponderance of evidence suggests that for training durations of 4 to 25 weeks shows no significant difference in the increase in strength or hypertrophy as a result of training with single versus multiple sets.

**Research 3.** A meta-analysis published in 2010 by the Journal of Pure Power, USA, comprising 8 studies, concluded that the effect on Hypertrophy for 1 set per muscle group was an average of 0.24, compared to 0.34 for 2-3 sets and 0.44 for 4-6 sets.

I want to highlight that 6 sets are the lowest end of conventional training methods, and in this meta-analysis was the higher end.

**Research 4.** Another study published in 2015 concluded that there's a dose response for the number of sets per exercise and a superiority of multiple sets compared with a single set per exercise for strength gains, muscle endurance, and upper arm muscle hypertrophy.

In conclusion, doing 3 to 5 sets per muscle group per week seems the optimal number of sets for maximal strength and hypertrophy, while 1 set failure proves as well to be effective with a considerable.

<sup>35</sup> https://pubmed.ncbi.nlm.nih.gov/9777681/)

# 4: The dangers of Over Training Syndrome (OTS)

It's the result of not allowing your body to recover between exercise sessions. It doesn't happen from one day to the other, since it's accumulative under recovery what causes Over Training Syndrome (OTS) After a certain point, too much exercise can be harmful to your health and hinder your results, especially if your workouts are close together. Here are some signs of OTS:

- Frequent Injuries
- Chronic Fatigue
- Irritability
- Muscle Pain
- Decreased Performance
- Poor Sleep
- Low Libido
- Reduced immune system (getting sick more often) recover between HIIT sessions and strength sessions since both put high amount of stress into our body.

Naturally, to prevent OTS you should not overdo your workouts. As a general rule, after 2 consecutive days of HIIT and/or strength training, plan an active rest day. This may include light activities yoga, meditation or stretching. Doing this will elicit greater results from your workouts. Remember to ditch the "no pain no gain" mentality, and welcome the "less pain more gain" mentality.

# 5: Maximizing Recovery

On top of not over working our body, we can further optimize our health and fitness levels by allowing our body to recover. In fact, if we don't allow our body to recover, we'll end up damaging it more in the long run. Other than resting and allowing our body to recover naturally, there are also a few more strategies we can apply to boost recovery.

**Maintain a healthy nutrition intake.** For better recovery, make you sure you have a healthy nutrition that delivers all nutrients that your body needs, especially protein, since it's the macronutrient that will help to maintain and increase your muscle mass.

**Stay hydrated.** Dehydration can impair your muscles' ability to repair themselves and performance will be significantly reducing after losing only 2% of water in your body. To put in perspective, you can go without food up for weeks or even months (depending on your body fat levels) before dying, but in a few days (average 3-5 days) you can die if you don't get water.

**Get enough sleep.** Think about it, we spend around ¼ of our life sleeping, only this makes clear how important is for optimal health and life in general. Not having enough sleep every day will decrease your immune system, elicit weight gain, weaken your heart, and reduces your mood, productivity, and memory, and harm exercise performance. To put it into perspective, you can die if you don't get enough sleep. (The longest period ever recorded without sleep is 11 days.) A good quality sleep is scientifically defined by:

- Falling asleep within 30 minutes (or less) of getting into bed
- Sleeping straight through the night without waking up (more than once)
- Being able to sleep the recommended number of hours for your age group (7 to 9 hours)

**Massage therapy.** In 2020 a systematic review and meta-analysis on the Effect of sports massage on performance and recovery<sup>36</sup>, results show that massage has a small but significant effect on improving flexibility and decreasing delayed onset muscle soreness after exercise.

Similarly, another study<sup>37</sup> found that massage therapy is proven to also reduce stress hormones (cortisol) and increase happiness hormones (dopamine and serotonin).

**Cryotherapy.** Cryotherapy is another tool for recovery, specifically muscle recovery. Cryotherapy is the technique of exposing your body to an extremely cold temperature for a short amount of time. It can speed up recovery by reducing pain, inflammation, and muscle tiredness after strenuous activity.<sup>38</sup>

**Sauna therapy**<sup>39</sup>**.** Sauna therapy on the other hand, uses heat instead of cold temperature to increase muscle strength, and reduce pain and fatigue.

<sup>&</sup>lt;sup>36</sup> <u>https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7228568/</u>

<sup>&</sup>lt;sup>37</sup> https://www.tandfonline.com/doi/full/10.1080/00207450590956459

<sup>&</sup>lt;sup>38</sup> <u>https://www.frontiersin.org/articles/10.3389/fphys.2017.00258/full</u>

<sup>&</sup>lt;sup>39</sup> <u>https://pubmed.ncbi.nlm.nih.gov/31126560/</u>

**Contrast water therapy (contrast hydrotherapy).** Contrast water Therapy (Hot/Cold) is essentially repeated immersions in water, switching between warm and cold temperatures. Much like cryotherapy and sauna therapy, research shows that contrast hydrotherapy can also help reduce muscle fatigue, pain, swelling, and additionally, lactic acid buildup after an intense exercise.<sup>40</sup> Although the magnitudes of these effects seem to be clinically relevant, but it may be most applicable to elite sport.

<sup>&</sup>lt;sup>40</sup> https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3633882/

# 6: Exercise and metabolism

#### Hormones that Help Us Burn Fat

**Growth Hormone.** Growth hormone (HGH) it's produces by the pituitary gland, it helps maintain muscle mass, cell repair, and metabolism. It boosts, strength, and exercise performance, while helping you recover from injury and disease. Low HGH is linked to obesity, low energy levels and increase all-cause mortality.<sup>41 42 43</sup>

#### How to boost growth hormone through nutrition

- **Fasting:** Multiple studies links fasting with increased HGH levels up to 1.250%. At the same time, it'll help lower insulin and glucose levels.<sup>44 45 46</sup>
- Reduce sugar intake: An increase in insulin is associated with lower HGH levels.

Refined carbs and sugar raise insulin levels the most, so reducing your intake may help optimize growth hormone levels.<sup>47 48</sup>

#### How to boost growth hormone through exercise and body composition:

• Losing body fat: Those with higher levels of belly fat will likely have impaired HGH production and an increased risk of disease.<sup>49</sup> One study observed that those with three

<sup>&</sup>lt;sup>41</sup> Effects of human growth hormone in men over 60 years old: <u>https://pubmed.ncbi.nlm.nih.gov/2355952/</u>

<sup>&</sup>lt;sup>42</sup> Abdominal visceral fat and fasting insulin are important predictors of 24-hour GH release independent of age, gender, and other physiological factors: <u>https://pubmed.ncbi.nlm.nih.gov/11502822/</u>

<sup>&</sup>lt;sup>43</sup> Growth hormone deficiency in adulthood and the effects of growth hormone replacement: a review. Growth Hormone Research Society Scientific Committee: <u>https://pubmed.ncbi.nlm.nih.gov/9467546/</u>

<sup>&</sup>lt;sup>44</sup> Fasting: the history, pathophysiology and complications: <u>https://pubmed.ncbi.nlm.nih.gov/6758355/</u>

<sup>&</sup>lt;sup>45</sup> Augmented growth hormone (GH) secretory burst frequency and amplitude mediate enhanced GH secretion during a two-day fast in normal men: <u>https://pubmed.ncbi.nlm.nih.gov/1548337/</u>

<sup>&</sup>lt;sup>46</sup> Fasting enhances growth hormone secretion and amplifies the complex rhythms of growth hormone secretion in man: <u>https://pubmed.ncbi.nlm.nih.gov/3127426/</u>

<sup>&</sup>lt;sup>47</sup> Elevated insulin levels contribute to the reduced growth hormone (GH) response to GH-releasing hormone in obese subjects: <u>https://pubmed.ncbi.nlm.nih.gov/10484056/</u>

<sup>&</sup>lt;sup>48</sup> The plasma sugar, free fatty acid, cortisol, and growth hormone response to insulin. I. In control subjects: <u>https://www.ncbi.nlm.nih.gov/pmc/articles/PMC292717/</u>

<sup>&</sup>lt;sup>49</sup> Massive weight loss restores 24-hour growth hormone release profiles and serum insulin-like growth factor-I levels in obese subjects: <u>https://www.ncbi.nlm.nih.gov/pubmed/7536210</u>

times the amount of belly fat as the control group had less than half their amount of HGH.<sup>50</sup>

#### • Perform High Intensity Interval Training (HIIT)

Exercise is one of the most effective ways to significantly raise your HGH levels, being HIIT the type of exercise that improves HGH the most.<sup>51</sup>

**IGF-1** stands for "insulin-like growth factor." It's called "insulin-like" because it is very similar to insulin, and they compete for the same receptors on the cell membrane. When you are a sugar burner, the primary pump delivering fuel for your cells is insulin. And this is a problem because insulin is the fat-making hormone, delivering fat-making messages that we'd prefer our cells not hear. Additionally, insulin is darn good at its job—the more insulin you've got circulating in your bloodstream, the fatter you get. IGF-1, on the other hand, is a fat-burning hormone. It therefore stands to reason that when you're a fat burner, your cells are "listening" to IGF-1. Theoretically, insulin should only be elevated for a short time, a few times a day, right after you've eaten. Which is a good thing. The rest of the time, your cells should be getting their fuel primarily from the IGF-1 fuel pump.

But why is this important? Well, pull up a chair.

IGF-1 feeds the cells much like insulin does, but it also sends a number of important signals to the body at the same time. One of those signals is to rebuild and repair your most metabolically active tissue—your M.A.T.—which includes your organs, glands, bones and nerves. And what does IGF-1 use to feed all those cells? Your fat. That's why it also sends a signal that tells your fat cells to open up and release all of the stored fat inside. as opposed to filling them up the way insulin does. IFG-1 breaks into the fat storage banks, releasing fat from the fat cells so that it can be used to feed the rest of your body.

<sup>&</sup>lt;sup>50</sup> Novel Relationships of Age, Visceral Adiposity, Insulin-Like Growth Factor (IGF)-I and IGF Binding Protein Concentrations to Growth Hormone (GH) Releasing-Hormone and GH Releasing-Peptide Efficacies in Men during Experimental Hypogonadal Clamp: <u>https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2690428/</u>

<sup>&</sup>lt;sup>51</sup> Impact of acute exercise intensity on pulsatile growth hormone release in men: <u>https://www.ncbi.nlm.nih.gov/pubmed/10444604</u>

**Catecholamines; adrenaline and noradrenaline:** These hormones are released by the adrenal glands and some neurons. They increase in heart rate, blood pressure, and breathing rate.

**Leptin:** This hormone is released by the fat cells as a measure of protection. Leptin is what tells your brain that our fat cells—are full (or empty).

In fact, leptin is actually released by the fat cells, in direct proportion to how full they are. When leptin is present in high levels, it sends a signal to our brain that we're full and should stop eating. When leptin levels are low, the opposite happens: we feel hungry and crave food.

This is how the body communicates with the brain and inform about the amount of fat stores. When our body is in balance, the system works efficiently, but when we consume high amount of sugar (sugar burner), the system is breaks. Your brain never gets the leptin message, you're hungry all the time, even though your fat-storage tanks are bursting at the seams, and the whole hormonal fat-burning symphony is playing horribly out of tune.

The reason for this is because your brain has become insensitive to leptin's messages. Contrary to what you might expect, obese people have tons of leptin. The problem is that their leptin isn't getting into their brains, so it never gets chance to deliver the message to "stop eating!"

This happens because, when exposed to high levels of leptin, the brain becomes resistant to its effects. If this kind of hormonal resistance sounds familiar, it's because it is. You'll recall that the exact same thing happens in insulin resistance, except in that case it's the muscle cells becoming "resistant" to the effects of insulin. If your brain cells are becoming resistant to leptin, here's what happens:

- 1. You feel compelled to eat constantly. This is one reason most "crash diets" are ineffective. When you lose a lot of weight quickly, leptin levels plummet
- 2. Your body responds to this perceived deficit of leptin by increasing appetite and at some point, you begin to gain the weight right back since your body is signaling your brain that you should eat.
- 3. Your entire metabolism slows down to accommodate this perceived starvation. Your thyroid slows down and your overall metabolic rate drops. This means that your body is actually making you fatter even if you eat the same amount as before. Your body has

learned to run on less fuel because it thinks you're starving. The amount of food you ordinarily eat is now considered "excess" calories for your slowed down metabolism, and your body stores those "extra" calories as fat.

To put it simply, you become a sugar burner instead of a fat burner. You eat more, you burn less fat, your growing fat cells produce even more leptin, but instead of responding to it (like someone with a functioning, fat-burning metabolism would) you become more resistant to it and you get fatter every second of the day. It's a vicious cycle.

**Thyroid.** It manufactures hormones that regulate your body's metabolism. "Every single muscle, organ and cell in the body depends on adequate thyroid hormone levels for achieving and maintaining optimal functioning." Constantly eating devitalized food will result in deficiencies of vitamins, minerals and other essential products and will inevitably lead to hormonal and immune system abnormalities." Sugar and refined carbohydrates among the major culprits.

#### Hormones that Cause Us to Gain Weight

There are two main types of hormones that contribute to weight gain:

- Cortisol
- Insulin

#### Cortisol

Cortisol is a stress hormone released by the adrenal glands. The brain triggers the release of cortisol to help us to deal with stressful situations. In the short term, cortisol is meant to help us by elevating our energy level and attention, but chronic, high levels may cause weight gain and high blood pressure, disrupt sleep, negatively impact mood, reduce your energy levels and contribute to diabetes. Cortisol stimulates fat and carbohydrate metabolism for fast energy. It stimulates insulin release and maintenance of blood sugar levels, causing our body to eventually increase appetite and cravings for sweet, high-fat, and salty foods.

In Paleolithic times, the stress that led to a release of cortisol was often physical: for instance, being chased by a predator. Cortisol is essential in preparing our bodies for action — to fight or flee. Cortisol's main function is to substantially enhance glucose availability, which provides energy for muscles—very necessary in helping us to run and avoid being eaten, all available

energy is directed toward surviving the stressful event. When that happens, growth, digestion and other long-term metabolic activities are temporarily restricted. Proteins are broken down and converted to glucose (gluconeogenesis). Vigorous physical exertion (fight or flight) soon often followed, burning up these newly available stores of glucose. Shortly thereafter, we were either dead, or the danger was past and our cortisol decreased back to its normal low levels.

And that's the point: the body is well adapted to a short-term increase in cortisol and glucose levels. Over the long term, however, a problem arises.

You see, stress is a short-term mechanism to help us survive, it's not meant to be turned on consistently. Due chronic psychological stress, the same mechanism that has helped humanity not go extinct, is producing the opposite effect nowadays. As we have explained, when in stressful situation, cortisol signals the body to release glucose for fat energy, but more often than not, we actually do not use that energy in a modern environment, causing us to have we have excess sugar in our bloodstream.<sup>52</sup>

And this is where insulin comes into play.

How to reduce Cortisol:

- Balance the amount of Intense Exercise
- Get good quality sleep
- Deep Breathing<sup>53</sup>
- Mindfulness<sup>54</sup>
- Massage therapy<sup>55</sup>

<sup>&</sup>lt;sup>52</sup> Cortisol levels increased but perceived stress, strongly correlated with increased levels of both glucose and insulin: <u>https://pubmed.ncbi.nlm.nih.gov/9626108/</u>

<sup>&</sup>lt;sup>53</sup> The role of deep breathing on stress: <u>https://pubmed.ncbi.nlm.nih.gov/27995346/</u>

<sup>&</sup>lt;sup>54</sup> <u>https://www.ncbi.nlm.nih.gov/pubmed/18842742</u>

<sup>&</sup>lt;sup>55</sup> Cortisol decreases and serotonin and dopamine increase following massage therapy: <u>https://www.ncbi.nlm.nih.gov/pubmed/16162447</u>

#### Insulin

Insulin is a hormone made in your pancreas and allows your body to use glucose for energy. Glucose is a type of sugar found in many carbohydrates. When our cells absorb too much glucose (because of overeating, for example), our body will convert glucose into fat, leading to weight gain.

High insulin secretion has long been associated with obesity.<sup>56</sup> Obese people secrete much higher levels of insulin than do those of normal weight. Also, in lean subjects, insulin levels quickly return to baseline after a meal, but in the obese, these levels remain elevated.

Insulin levels are almost 20 percent higher in obese subjects, and these elevated levels are strongly correlated to important indices such as waist circumference and waist/hip ratio.

#### Insulin Resistance

People who are obese or have unhealthy habits such as smoking, skimping on sleep, or eating unhealthily are more likely to develop insulin resistance. Insulin resistance is defined clinically as the inability of a known quantity of exogenous or endogenous insulin to increase glucose uptake and utilization in an individual as much as it does in a normal population.

Another important cause of insulin resistance is not watching out for when we eat.

There are a few myths that it's time to eliminate because they are causing by health problem, actually this paper is meant to give an entire perspective, fact and science-based perspective, on most of common believes regarding nutrition. We've been sold the idea that 6 meals a day are better than 3.

In the 70's, when obesity rates were low compared to nowadays, the average number of meals was 3 (breakfast, lunch and dinner) and in the 2000s is average 5-6 meals.<sup>57</sup> But in the development of obesity, the increase in meals is almost twice as important as the change in diet; increase eating/drinking occasion and portion size have accounted for most of the change

<sup>&</sup>lt;sup>56</sup> Insulin and weight gain: <u>https://pubmed.ncbi.nlm.nih.gov/11574431/</u>

<sup>&</sup>lt;sup>57</sup> <u>https://pubmed.ncbi.nlm.nih.gov/20237134/</u>

in total energy intake. These findings suggest a new focus for efforts to reduce energy imbalances in US adults.<sup>58</sup> You might be wondering, why this is important? Because for insulin resistance to happen, we need consistent elevated insulin.

However, insulin resistance can be reversed. Using synthetic cortisol, we can increase insulin experimentally. In a study, healthy volunteers given high-dose cortisol increased their insulin levels 36 percent above their baseline.<sup>59</sup>

In essence, exercising reduces the number of stress hormones, such as cortisol, which causes us to gain weight. As we exercise, we're also increasing the levels of growth hormones and testosterone, enabling fat to be used as energy. Exercising regularly also reduces the amount of free fatty acids in the bloodstream that can contribute to leptin resistance.

# 7: Taking Action

An efficient and effective weekly exercise routine is to maximize your health after taking all barriers of exercise into consideration. To start taking action, don't presume that it's difficult. It's actually relatively easy if you plan out your routine based on scientific research. Here's the simplest way you can get started and the tools you *might* need (optional).

What you need: Your body and ideally some resistance in form of a resistance band or dumbbells, not gym or expensive equipment required.

**Wher**e: Get started right at home with HIIT! We should focus on HIIT and functional training. As you have learned, focus on intensity, and allow recovery times.

<sup>&</sup>lt;sup>58</sup> <u>https://pubmed.ncbi.nlm.nih.gov/21738451/</u>

<sup>&</sup>lt;sup>59</sup> Increasing insulin using synthetic cortisol: <u>https://pubmed.ncbi.nlm.nih.gov/7917157/3</u>

**Duration:** You really only need a minimum of 10 minutes to a maximum of 30 minutes a day, 3 to 5 times a week. If you'd like to work out from Monday to Friday, you can create a workout 5 d-y workout routine with one extra day to focus on stretching and low intensity exercise to maximize recovery.

# Here are a few more options for you to plan out your exercise routine to build it into a sustainable, life-long, habit.

- 3 DAYS A WEEK OPTION
  - Monday: HIIT
  - Wednesday: Strength Training
  - Friday: HIIT
- 4 DAYS A WEEK OPTION
  - Monday: HIIT
  - Tuesday: Strength Training
  - Thursday: HIIT
  - Friday: Strength Training
- 5 DAYS A WEEK OPTION
  - Monday: HIIT
  - Tuesday: Strength Training
  - Wednesday: Stretch, Light exercise
  - Thursday: HIIT
  - Friday: Strength Training

#### **FINAL WORDS**

Remember that exercise is only one part of our healthy lifestyle and staying active is a must to achieve optimal health. improving your fitness levels is relatively easy and takes minimal amount of time. Choose an exercise activity that you enjoy, that is suitable for your lifestyle and adapted to your fitness level Remember that exercise for optimal health is not optional if you want to be the be the healthiest version of yourself, humans are meant to move, lift things, and have low levels of chronic stress.

Improving your fitness doesn't need to take you more than 1 hour a week, and that alone, improve your quality of life, reduce your risk of all-cause mortality, improve your body composition, and health while prolonging your life and your health span. Start small, take one step at a time with the main goal of making exercise a long-term habit.