Exercise prescription for health: 
Italian perspective.
Italian guidelines for exercise prescription in healthy adults (18-65 years)

Prescrizione dell’Attività Fisica per la Salute: 
La Prospettiva Italiana.
Linee guida italiane di prescrizione dell’attività fisica per adulti sani (18-65 anni)

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SUMMARY
Exercise prescription has been widely deepened and discussed by National and International Organizations. Lack of physical activity has been demonstrated to be associated to premature all causes mortality and chronic diseases. Although developing an active lifestyle is one of the most effective preventive treatment for chronic diseases, more than 25% of adults doesn’t match the current guidelines about physical exercise around the world. The existing guidelines suggest the practice of moderate-intensity physical activity in combination with muscle-strengthening and flexibility exercises; none of them takes into consideration sedentariness and the amount of exercise performed during everyday-life activities. The aim of this article is to guide clinicians in exercise prescription by reviewing current international guidelines and introducing the new concept of “corrections factors”: the amount of sedentary time is converted in more minutes of physical exercise; daily-life activities (e.g. steps) lessen the amount of time a person should perform physical exercise. These guidelines are currently under review to be utilized by Italian Health system as fundamental reference for exercise prescription.


KEY WORDS: Guidelines; Exercise; Health promotion; Italy.

RIASSUNTO
La prescrizione dell’attività fisica è stata ampiamente approfondita e discussa da diverse Organizzazioni nazionali ed internazionali. È stato dimostrato come la mancanza di attività fisica sia associata a morte prematura e malattie croniche. Sebbene uno stile di vita attivo sia uno dei trattamenti preventivi più efficaci per le malattie croniche, oltre il 25% degli adulti a livello mondiale non rispetta le attuali linee guida sull’esercizio fisico. Le attuali linee guida suggeriscono di praticare attività fisica di intensità moderata in combinazione con esercizi di forza e flessibilità; nessuna di loro prende però in considerazione la sedentarità e la quantità di esercizio fisico svolto durante le attività della vita quotidiana. Questo articolo si propone di guidare i medici nella prescrizione dell’esercizio rivedendo le attuali linee guida internazionali e introducendo il nuovo concetto di “fattori di correzione”: la quantità di tempo sedentario viene...
Introduction

Health benefits of physical exercise

The benefits of regular physical exercise on health have been widely demonstrated, whereas inadequate physical activity levels have been associated with about 10% of premature mortality and about €100 billion in annual healthcare costs.1-3

Unquestionable evidences show that meeting WHO recommendations (150 min of moderate-intensity aerobic physical activity or 75 min of vigorous-intensity aerobic physical activity, or an equivalent combination each week, adding muscle-strengthening activities that are moderate or high intensity and involve all major muscle groups on 2 days/week at least) is associated with a remarkable reduction of either mortality and risk for more than 20 chronic diseases.4 Although some benefits can be obtained also by reducing sedentary time, the key element is to avoid inactivity and exercise is essential to maintain a good health status in healthy individuals and in people with chronic conditions or disabilities.5

The largest benefit occurs when sedentary individuals shift from being inactive to being sufficiently active. Even low amounts of moderate-to-vigorous intensity physical activity can reduce the risk of all-cause mortality.6 Then, the relative risk of all-cause mortality continues to decline as people become even more physically active. A consistent finding from research studies confirms that, once the health benefits from physical activity begin to accumulate, increased amounts of activity provide additional benefits.5 Physical activity has been proven to reduce effectively cardiovascular risk, to contribute to weight control and loss, to decrease the risk of metabolic syndrome and type 2 diabetes, to increase mineral bone density and muscle mass and also to positively impact mental health.7-15

Starting from cardiovascular risk prevention, a relevant point to be highlighted is the dose-effect relationship between exercise and risk convertita in un numero superiore di minuti di esercizio fisico; le attività della vita quotidiana (ad esempio i passi) riducono la quantità di tempo di esercizio fisico che la persona deve svolgere. Queste linee guida sono attualmente in fase di revisione per essere utilizzate dal sistema sanitario italiano come riferimento fondamentale per la prescrizione di attività fisica.

Parole chiave: Linee guida; Esercizio fisico; Promozione della salute; Italia.
of death from cardiovascular diseases (CVD), as reported by several studies. \cite{16, 17} The same association has been demonstrated between cardiopulmonary fitness (CRF) and the risk of developing heart diseases. At this regard, Paffenberger et al. showed that subjects with higher levels of fitness and physical activity face a reduced risk of premature death related to CVD. \cite{18} In particular, an energy expenditure of 4200 kJ/settimana has proved to be effective in blocking CVD progression. Interestingly, even volumes below the recommended (an amount around 2100 kJ/settimana) still lead to a considerably decreased risk. Furthermore, Stofan et al. reported a 60% reduction in all-cause and CVD mortality rates in subjects with moderate CRF \cite{19} (8-9 MET x h/settimana, estimated through treadmill test), compared to individuals with lower CRF.\cite{19}

However, although the majority of existing studies focused on men, emerging data indicate these relationships also exist in women. \cite{20} Moreover, regular physical activity can positively influence blood pressure. The risk of developing hypertension is reduced in normotensive people regularly engaging physical activity. Similarly, hypertensive individuals get important benefits on both systolic and diastolic blood pressures. Both aerobic and muscle-strengthening activities are recommended to correct blood pressure. \cite{21} Even amounts of physical activity below the recommended levels tend to positively impact on blood pressure and engaging in greater physical activity can have even greater benefits. \cite{22} Physical activity is also fundamental for secondary prevention after a cancer diagnosis (particularly breast cancer). \cite{23} A dose–response trend has been highlighted with an inverse association between increased post-diagnostic physical activity level and all-cause and breast cancer-specific mortality, as well as a higher mortality risk among women who reduced their post-diagnostic exercise levels. \cite{24}

Exercises aimed at increasing muscle mass and strength have specific effects on bone mineral density and content. People affected by osteoporosis can benefit from exercise training, which might slow down or even reverse the loss of bone mass. \cite{25} Active people, especially women, also seem to have a lower risk of hip fracture compared to their inactive peers. \cite{15}

Regular physical exercise has also been proven to enhance mental health. In particular, exercise prescription for health in Italy
lar, progression of mild to moderate depressive disorders and anxiety may be slowed down by regular practice of physical activity. Modest changes in physical activity levels in the general population could potentially lead to relevant public mental health benefits, thus to a significant reduction of new depression cases. A physically active lifestyle may also increase cognitive function and is associated with a lower risk of dementia and Alzheimer disease (AD). Improvements from physical activity are present in people with normal or impaired cognitive health, including conditions such as schizophrenia, multiple sclerosis, Parkinson’s disease, and stroke. Moreover, regular physical activity improves cognitive functions among youth and adults, including memory, attention and executive functions. Finally, moderate-to-vigorous physical activity has been demonstrated to promptly improve the quality of sleep in adults. These are mainly related to the reduction in the length of time it takes to sleep, reduction of the time of awaking after going to sleep and before rising in the morning.

Epidemiology of physical activity around the world

The development of a physically active lifestyle provides one of the cheapest and more effective preventative treatments for fighting chronic diseases, as well as a valuable resource for promoting equity in physical activity. In light of these considerations, promoting a physically active lifestyle may represent the most effective strategy for improving general health.

According to a study on American adults (18 to 65 years-old), about half of the subjects complies with aerobic exercise guidelines (thus classified as sufficiently or highly active) while the remaining 50% is non-active or insufficiently active (Table I). 22

Table I.—Data on prevalence of physical activity in healthy adults in the USA. Highly active (>300 min/week of activity, >150 min/week of intense activity or equivalent combination), sufficiently active (150-300 min/week of activity, 75-150 min/week of vigorous activity, or equivalent combination), insufficiently active (any physical activity that does not meet any of the previous parameters), inactive (no activity that equals or exceeds 10 min) (from Fulton). 22

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Highly active</th>
<th>Sufficiently active</th>
<th>Insufficiently active</th>
<th>Inactive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age-adjusted prevalence</td>
<td>34.0%</td>
<td>15.7%</td>
<td>20.0%</td>
<td>30.2%</td>
</tr>
</tbody>
</table>
Aerobic physical activity is smaller than that of disabled adults who follow guidelines for
uals, the research shows that the proportion below diploma level. As for impaired individ-
ates show the highest prevalence in meeting
asymmetry and disability. In fact, college grad-
sure time exercise participation are educational
addition to that, other aspects influencing lei-
sta forma di attività raggiunga la dose minima
rispetto ai bianchi, sebbene non sia chiaro se que-
Sebbene i benefici dell’attività fisica siano ben noti in tutto il mondo, i dati presentati in Tabella I e in Tabella III evidenziano la necessità di aumentare ulteriormente i livelli di esercizio fisico tra la popolazione generale americana ed europea, rispettivamente. Una scoperta chiave riportata da Hasson et al. è stata che l’adesione alle raccomandazioni della WHO varia in base al sesso, poiché gli uomini adulti hanno maggiori probabilità rispetto alle donne di conformarsi alle linee guida fornite (sia per l’allenamento aerobico che per la forza). Per quanto riguarda l’etnia, lo studio ha rilevato che le minoranze etniche accumulano livelli più elevati di attività fisica occupazionale rispetto ai bianchi, sebbene non sia chiaro se questa forma di attività raggiunga la dose minima necessaria per i benefici per la salute. Inoltre, altri aspetti che influenzano la partecipazione all’attività fisica nel tempo libero sono il livello d’istruzione e la disabilità. In effetti, i laureati mostrano la più alta prevalenza nel rispettare le linee guida, mentre i tassi più bassi si rilevano in persone la cui qualifica era inferiore al livello del diploma. Per quanto riguarda persone con disabilità, la ricerca mostra che la percentuale di adulti con disabilità che segue le linee guida per l’attività fisica aerobica è inferiore a quella
residential segregation (i.e. physical separation of two or more groups into different neighborhoods, based on criteria such as race, ethnicity, income) is shown to have an impact on participation in physical activity. Individuals living in underprivileged environments, where access to exercise facilities is limited, face a more challenging context when wishing to engage in physical activity.

Another study provides a description of global regional and country levels of insufficient physical activity and trends over time (from 2001 to 2016). The analysis included 358 populations-based surveys done between 2001 and 2016 with 1.9 million participants from 168 countries: the availability of data across income groups and regions was spread fairly evenly, with the exception of Latin American and Caribbean countries where just more than half of countries had data. Globally, more than a quarter of adults (27.5%) were insufficiently physically active in 2016. Between 2001 and 2016, levels of insufficient physical activity have decreased only marginally and significantly, with a global prevalence of 28.5% in 2001. Women were less active than men, with a prevalence difference of 6% between sexes in 2001 (25.5% for men, and 31.5% for women), and of more than 8% in 2016 (23.4% for man and 31.7% for women).

In the same period the prevalence of physical inactivity increased by more than 5% in high-income Western countries (from 30.9% in 2001 to 36.8% in 2016) and in Latin America and Caribbean (from 33.4% in 2001, to 39.1% in 2016), whereas east and southeast Asia had a decrease of more than 5% (from 25.7% in 2001 to 17.3% in 2016). There was a difference between sexes of over 10% in central Asia, Middle East and northern Africa, high-income Western countries, and southern Asia. Prevalence of insufficient physical activity varied greatly across regions and income groups in 2016. Researchers found the highest levels in Latin America and the Caribbean, high-income Western countries, and high-income Asia Pacific, and prevalence was more than double in high-income countries than in low-income countries in 2016. In wealthier countries, the transition towards more sedentary occupations and personal motorized transportation probably explains the higher levels of inactivity. Conversely, in lower-income countries, more activity is undertaken at work and for transport; however, these behaviors are changing of the adults without disability. Among others, also the residential segregation (meaning the separation of two or more groups in different neighborhoods, based on criteria such as race, ethnicity, income) has an impact on participation in physical activity. Individuals living in underprivileged environments, where access to exercise facilities is limited, face a more challenging context when wishing to engage in physical activity.

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ing rapidly. The analysis, including data from nearly 2 million participants (representing 96% of the global population), shows that globally, in 2016, more than a quarter of all adults was not getting enough physical activity. Previous estimates showed a global prevalence of insufficient physical activity of 23.3% in 2010. This difference from these results is due to the inclusion of nearly twice as many surveys (358 vs. 195), and production of esteem for 22 more countries.

The global prevalence of physical inactivity was stable between 2001 and 2016, suggesting no progress in reducing global levels to reach the 2025 global physical activity target. However, a wide variation in trends in inactivity regions has been found across income groups and countries. The largest increases in insufficient physical activity have occurred in high-income countries, whereas the largest decreases have occurred in east and southeast Asia. These decreases are largely explained by increased participation in physical activity in China, the most populous country in the region. These data show that progress towards the global target set by WHO member states to reduce physical inactivity by 10% by 2025 has been too slow and is not on track. Levels of insufficient physical activity are particularly high and still rising in high-income countries, and worldwide, women are less active than men. A significant increase in national action is urgently needed in most countries to scale-up the implementation of effective policies.

**Summary of international physical activity guidelines**

“Doing any physical activity is better than doing none. If you currently do no physical activity, start by doing some, and gradually build up to the recommended amount”; “If you are not physically active (moving much), it’s not too late to START NOW! Do regular physical activity and reduce sedentary activities.”

Physical inactivity is now identified as the fourth leading risk factor for global mortality. Sedentariness levels are rising in many countries with major implications for the prevalence of noncommunicable diseases and the general health of the global population. In order to counteract this global concern, different organizations and institutions worldwide have recently developed physical activity guidelines helping experts to prescribe exercise training

milioni di partecipanti (che rappresentano il 96% della popolazione globale), mostra che a livello globale, nel 2016, oltre un quarto di tutti gli adulti non ha praticato abbastanza attività fisica. Stime precedenti hanno mostrato una prevalenza globale di attività fisica insufficiente del 23,3% nel 2010. La differenza rispetto a questi risultati è dovuta all’inclusione di quasi il doppio di sondaggi (358 vs. 195) e alla produzione di stima per altri 22 paesi. La prevalenza globale di inattività fisica è rimasta stabile tra il 2001 e il 2016, suggerendo che non sono stati fatti progressi nella riduzione di tale percentuale per raggiungere l’obiettivo di attività fisica globale del 2025. Tuttavia, è stata riscontrata un’ampia variazione nelle tendency all’interno delle regioni di inattività tra gruppi di reddito e paesi. I maggiori aumenti di attività fisica insufficiente si sono verificati nei paesi ad alto reddito, mentre i maggiori decrementi si sono verificati nell’est e nel sud-est asiatico. Queste riduzioni sono in gran parte spiegate da una maggiore partecipazione all’attività fisica in Cina, il paese più popoloso della regione. Questi dati mostrano che i progressi verso l’obiettivo globale fissato da gli Stati membri della WHO per ridurre l’inattività fisica del 10% entro il 2025 sono stati troppo lenti e non sono sulla buona strada. I livelli di attività fisica insufficiente sono particolarmente elevati e continuano ad aumentare nei paesi ad alto reddito, e in tutto il mondo le donne restano meno attive degli uomini. Nella maggior parte dei paesi è necessario un urgente aumento significativo dei piani nazionali per potenziare e migliorare le attuali politiche.

Riepilogo sulle line guida internazionali per l’attività fisica

“Fare qualsiasi tipo di attività fisica è meglio che non farne. Se al momento non svolgi alcuna attività fisica, inizia a farne un po’ e gradualmente aumenta fino alla quantità consigliata”; “Se non sei fisicamente attivo (non ti muovi molto), non è troppo tardi per INIZIARE ORA! Fai attività fisica regolare e riduci le attività sedentarie.”

L’inattività fisica è ora classificata come il quarto principale fattore di rischio per la mortalità globale. I livelli di sedentarità sono in aumento in molti paesi, con importanti implicazioni sulla prevalenza di malattie non trasmissibili e sulla salute generale della popolazione mondiale. Al fine di contrastare questa preoccupazione globale, diverse organizzazioni e istituzioni in tutto il mondo hanno recentemente sviluppato linee guida per l’attività fisica al fine di aiutare gli esperti a prescrivere un allenamento fisico alla popolazione
to general population. These guidelines aim to get people closer to physical activity, thus including exercise training in their own daily and/or weekly routine.

Table IV reports some of the international guidelines for physical activity for healthy individuals aged 18-64 years. The majority of existing international physical activity guidelines suggest the practice of moderate-intensity physical activity on most (preferably all) days of the week, in combination with muscle-strengthening and flexibility exercises twice a week.

Table IV.—International physical activity guidelines for healthy adults (18-64 years old).

<table>
<thead>
<tr>
<th>Reference/country</th>
<th>Aerobic activity</th>
<th>Strength, flexibility and balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACSM28, 29</td>
<td>150 min/week of moderate-intensity or 75 min/week of vigorous-intensity or a combination of these. Each session should last at least 10 min</td>
<td>Resistance exercises for 2-3 days/week involving the major muscle groups</td>
</tr>
<tr>
<td>ACSM/AHA30</td>
<td>A minimum of 30 min on 5 days/week of moderate-intensity, or a minimum of 20 min on 3 days/week of vigorous-intensity activity. Each bout should last at least 10 min</td>
<td>Flexibility exercises for each the major muscle-tendon groups (a total of 60 s per exercise) at least 2 days/week</td>
</tr>
<tr>
<td>Australia31, 32</td>
<td>At least 150 min of moderate intensity or 75 min of vigorous intensity, or an equivalent combination of moderate and vigorous activities, each week</td>
<td>Exercises for balance, agility and coordination should be engaged for 2-3 days/week</td>
</tr>
<tr>
<td>Austria33</td>
<td>150 min/week of moderate-intensity or 75 min/week of vigorous-intensity. Each session should last at least 10 min</td>
<td>Activities to increase or maintain muscular strength and endurance at least two days per week</td>
</tr>
<tr>
<td>Belgium34</td>
<td>30 min on 5 days/week of moderate-intensity (or 60 min if of low intensity or less than 5 days/week), or 20 min on 3 days/week of vigorous-intensity. Each bout should last at least 10 min</td>
<td>Activities for muscular strength at least 2 days/week</td>
</tr>
<tr>
<td>Canada35, 36</td>
<td>At least 150 min of moderate- to vigorous-intensity per week, in bouts of 10 min or more</td>
<td>Muscle-strengthening exercises for at least 2 days/week</td>
</tr>
<tr>
<td>CSEP37</td>
<td>At least 150 min of moderate- to vigorous-intensity per week, in bouts of 10 min or more</td>
<td>Muscle- and bone-strengthening activities that use major muscle groups, at least 2 days per week</td>
</tr>
<tr>
<td>Denmark38</td>
<td>At least 30 min ideally on 7 days/week of moderate-intensity, or 20-30 min on 2 days/week of vigorous-intensity</td>
<td>Muscle strength exercises for at least 2 days/week</td>
</tr>
<tr>
<td>France39</td>
<td>Thirty min of aerobic physical activity of moderate to high intensity should be practiced at least 5 days/week, while avoiding 2 consecutive days without PA</td>
<td>Muscle-strengthening activities for lower and upper limbs can be practiced during everyday activities (going up and down stairs, carrying loads, etc.) or in structured sessions once or twice a week with 1 or 2 days of recovery between two sessions</td>
</tr>
</tbody>
</table>

(To be continued)
Table IV.—International physical activity guidelines for healthy adults (18-64 years old).  
Tabella IV.—Linee guida internazionali sull’attività fisica per adulti sani (18-64 anni) 

<table>
<thead>
<tr>
<th>Reference/country</th>
<th>Aerobic activity</th>
<th>Strength, flexibility and balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany(^{40})</td>
<td>150 min/week of moderate-intensity or 75 min/week of vigorous-intensity or a combination of these. Each bout should last a minimum of 10 min.</td>
<td>Muscle-strengthening physical activity at least 2 days per week</td>
</tr>
<tr>
<td>Iceland(^{41})</td>
<td>30 min/day of moderate-intensity, or at least two times a week 20-30 min of vigorous-intensity physical activity</td>
<td>At least twice per week, 20-30 min vigorous PA to promote further fitness including strength</td>
</tr>
<tr>
<td>India(^{42})</td>
<td>At least 30 min of moderate-intensity aerobic activity every day. This should be performed in bouts of at least 10 min duration.</td>
<td>30 min of strengthening activities at least 3-4 days/week</td>
</tr>
<tr>
<td>Ireland(^{43})</td>
<td>At least 30 min a day of moderate activity on 5 days a week (or 150 min a week). These bouts should last for at least 10 min. Alternatively, at least 75 min a week of vigorous intensity</td>
<td>Activities which increase muscular strength and endurance on 2-3 days per week</td>
</tr>
<tr>
<td>Italy(^{44})</td>
<td>150 min/week of moderate-intensity or 75 min/week of vigorous-intensity or a combination of these. Engage 2-3 of light activity every 30 min of sedentariness</td>
<td>Muscle-strengthening physical activity at least 2 days per week</td>
</tr>
<tr>
<td>Luxembourg(^{45})</td>
<td>30 min/day of moderate-intensity exercise.</td>
<td>2 to 3 times/week strength, flexibility and balance training</td>
</tr>
<tr>
<td>The Netherlands(^{46})</td>
<td>30 min at least 5 days/week of moderate-intensity, or 20 min 3 times/week of vigorous-intensity.</td>
<td>Engage in activities that strengthen your muscles and bones at least twice a week</td>
</tr>
<tr>
<td>Norway(^{47})</td>
<td>30 min/day of moderate- or vigorous-intensity. Each bout should last at least 10 min.</td>
<td>Not specified</td>
</tr>
<tr>
<td>Russia(^{48})</td>
<td>150 min/week of moderate-intensity or 75 min/week of vigorous-intensity. Each session should last at least 10 min.</td>
<td>Strength training at least twice a week</td>
</tr>
<tr>
<td>Slovenia(^{49})</td>
<td>30 min/day of moderate-intensity at least 5 days/week Each bout should not be shorter than 10-15 min.</td>
<td>Exercise should be divided: 50% aerobic, 25% flexibility, 25% muscular strength</td>
</tr>
<tr>
<td>Sweden(^{47})</td>
<td>30 min/day of moderate- or vigorous-intensity. Each bout should last at least 10 min.</td>
<td>Not specified</td>
</tr>
<tr>
<td>Switzerland(^{50})</td>
<td>30 min/day of moderate-intensity exercise. Each bout should last at least 10 min.</td>
<td>Strength training (8-15 repetitions) and flexibility training, gymnastics and stretching exercises twice a week</td>
</tr>
<tr>
<td>Turkey(^{51})</td>
<td>30 min/day of moderate-intensity exercise.</td>
<td>Not specified</td>
</tr>
<tr>
<td>UK(^{52-54})</td>
<td>150 min/week of moderate-intensity, or 75 min/week of vigorous-intensity, or a combination of these. Each session should last at least 10 min.</td>
<td>Strength training at least 2 days/week</td>
</tr>
<tr>
<td>USA(^{55})</td>
<td>At least 150 min a week of moderate-intensity, or 75 min a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity. Each session should last at least 10 min and it should be spread throughout the week.</td>
<td>Muscle-strengthening activities that are moderate or high intensity and involve all major muscle groups on 2 or more days a week</td>
</tr>
<tr>
<td>WHO(^{27})</td>
<td>150 min/week of moderate-intensity or 75 min/week of vigorous-intensity or a combination of these. Each bout should last a minimum of 10 min.</td>
<td>Major muscle groups on 2 or more days a week</td>
</tr>
<tr>
<td>WHO Western Pacific Region(^{56})</td>
<td>At least 30 min of moderate-intensity exercise on five or more days each week in multiple blocks of 10-15 min sessions. For extra health benefits, perform 30 min of vigorous intensity twice a week and 20 min of outdoor sports 2 days/week.</td>
<td>Not specified</td>
</tr>
</tbody>
</table>
Potential pitfalls of current exercise prescription guidelines

Importance of the “right” dose of exercise: one size does not fit all

**Key Messages**

— Individual responses to exercise should be taken into consideration to define the “right” dose of exercise
— Non-responders to exercise do not exist

Physical activity guidelines from the USA and other countries (Table IV) do not clearly define whether there exists an upper limit of exercise amount (volume × intensity) in order to avoid possible disadvantages or problems coming from excessive physical activity. However, several studies have shown that strenuous exercise training may be associated with an increased risk of cardiac arrhythmias or sudden death following cardiac remodeling and changes in myocardial conduction.57, 58 Thus, some authors questioned the current physical activity guidelines suggesting the relationship between very high exercise levels and health deserves attention.

In 2015, a study by Arem et al.59 analyzed data collected through questionnaires by six studies belonging to NCI Cohort Consortium (population of 661,137 men and women) with the following objectives: 1) quantify the upper limit of benefit in terms of longevity for exercise, 2) define the risk of mortality associated with very high levels of exercise.59 The results showed that those who exercise less than recommended amounts (7.5 MET h/week) have a risk of mortality 20% lower than those who do not exercise, as opposed to 31% for those who exercise at frequency 1-2 times the recommended one and 37% for those who perform it at least 2-3 times (Figure 1).

Compliance with the guidelines was therefore associated with a mortality benefit close to the maximum achievable. On the other hand, there was no evidence of an increase mortality in high exercising subjects. Moreover, several large epidemiologic studies investigating mortality have consistently showed benefits for those participating in light and moderate physical activities, not showing a higher risk of mortality as activity levels increased.59-63 More specifically, Lee et al. demonstrated that running dose escalation at the highest levels is likely neither incrementally better nor worse.61

Potenziali limiti delle attuali linee guida di prescrizione dell’attività fisica

Importanza della “giusta” quantità di esercizio: una quantità non funziona per tutti

**Messaggi chiave**

— Le risposte individuali all’esercizio dovrebbero essere prese in considerazione per definire la quantità “giusta” di esercizio
— I non-responders all’esercizio fisico non esistono

Le linee guida per l’attività fisica proposte da Stati Uniti e altri paesi (Tabella IV) non definiscono chiaramente se esiste un limite superiore della quantità di esercizio (volume × intensità) al fine di evitare possibili svantaggi o problemi derivanti da un’eccessiva attività fisica. Tuttavia, diversi studi hanno dimostrato che un esercizio fisico intenso può essere associato ad un aumentato rischio di aritmie cardiache57, 58 o morte improvvisa a seguito di rimodellamento cardiaco e cambiamenti nella conduzione miocardica58. Pertanto, alcuni autori hanno messo in dubbio le attuali linee guida sull’attività fisica, suggerendo che la relazione tra livelli di esercizio molto elevati e la salute meriti attenzione.

In 2015, uno studio pubblicato su JAMA da Arem et al.59 ha analizzato i dati di sei studi appartenenti al Consorzio di coorte NCI (popolazione di 661,137 uomini e donne) raccolti attraverso questionari con i seguenti obiettivi: 1) quantificare il limite superiore di beneficio derivante dall’esercizio in termini di longevità, 2) definire il rischio di mortalità associato a livelli molto elevati di esercizio.59 I risultati hanno mostrato che coloro che esercitano una quantità inferiore a quella raccomandata (7,5 MET ore/week) hanno un rischio di mortalità inferiore del 20% rispetto a coloro che non si allenano, e del 31% rispetto a coloro che si allenano con una frequenza 1-2 volte superiore a quella raccomandata e del 37% per coloro che lo eseguono almeno 2-3 volte (Figura 1).

Il rispetto delle linee guida è stato quindi associato a un beneficio in termini di mortalità vicino al massimo ottenibile. D’altra parte, non vi era alcuna prova di un aumento della mortalità in soggetti che praticavano esercizi intensi. Inoltre, numerosi studi epidemilogici effettuati su vasti campioni di soggetti volti a studiare la mortalità, hanno dimostrato con costanza benefici per coloro che partecipano ad attività fisiche leggere e moderate, non riportando aumentato rischio di mortalità all’aumentare dei livelli di attività.59-63 Più specificamente, Lee et al. hanno dimostrato che l’aumento della quantità di esercizio verso volumi più alti non
Indeed, there was an increasing benefit from no exercise through a dose of 1 to 2.5 hours per week at a slow to moderate pace, with less clear evidence on higher levels of exercise. However, there was insufficient evidence to clearly state a maximum dose of running at which benefits become lost or outweighed by potential harms. Current data suggest that "more" is not necessarily better than moderate level but may not be either worse. Nevertheless, physicians should not discourage healthy people who already participate at the highest level of exercise from their chosen physical activity dose. The best approach would be to evaluate the individual response to exercise of the patient and prescribe, according to the data collected, the right dose of exercise needed to improve patient's health.

When exercise prescription is performed, another important issue that should be taken into account is that there are no evidences that a definite amount of exercise is essential and/or sufficient for everyone. About one adult in five who follows the indications for exercise provided by the 2008 US guidelines complains that they show no improvement (defined as non-responder). On the other hand, some subjects show health-related benefits from small amounts of exercise, even without following international guidelines. A recent study conducted by Montero et al. analyzed this phenomenon through an experimental study. Participants (78 healthy male subjects) underwent a physiological characterization ($W_{\text{max}}$ and $V_{\text{O2max}}$) during an incremental exercise. Then, each subject was able to choose among five

![Figure 1.—Graphic representation of dose/response effect with hazard ratios (HRs) of moderate to intense exercise and mortality (modified from Arem et al.)](Image)

Figure 1.—Graphic representation of dose/response effect with hazard ratios (HRs) of moderate to intense exercise and mortality (modified from Arem et al.).

porto né a maggiori benefici né a maggiori rischi per la salute. In effetti, è stato osservato un beneficio crescente passando da nessuna attività fisica a una dose corrispondente a 1-2,5 ore settimanali a ritmo lento o moderato, con prove meno chiare su livelli più elevati di esercizio. Tuttavia, non vi erano prove sufficienti per indicare chiaramente una quantità massima di corsa oltre la quale i benefici vengono persi o compensati da potenziali danni. I dati attuali suggeriscono che "di più" non è necessariamente meglio del livello moderato, ma potrebbe non essere neanche peggiore. Tuttavia, i medici non devono scoraggiare le persone sane che già praticano molto esercizio fisico dalla quantità di attività fisica prescelta. L’approccio migliore sarebbe valutare la risposta individuale all’esercizio del paziente e prescrivere, in base ai dati raccolti, la giusta quantità di esercizio necessaria per migliorare la sua salute.

Quando viene prescritta l’attività fisica, un altro aspetto importante che dovrebbe essere preso in considerazione è che non ci sono prove che una determinata quantità di esercizio sia essenziale e/o sufficiente per tutti. Circa un adulto su quindici che segue le indicazioni fornite dalle linee guida statunitensi del 2008 si lamenta di non mostrare alcun miglioramento (definito come non-responder). D’altra parte, alcuni soggetti mostrano benefici sulla salute anche solo praticando piccole quantità di esercizio senza seguire le linee guida internazionali. Un recente studio condotto da Montero et al. ha approfondito questo fenomeno attraverso uno studio sperimentale. I partecipanti (78 soggetti maschi sani) sono stati sottoposti a una caratterizzazione fisiologica ($W_{\text{max}}$ e $V_{\text{O2max}}$) durante un esercizio incrementale. Ogni soggetto era libero di scegliere tra 5 gruppi di allenamento che differivano nel numero di allenamenti settimanali (da 1 a 5 sessioni settimanali). Alla fine del periodo di allenamento (6 settimane) la maggior parte dei soggetti ha migliorato il proprio fitness cardiorespiratorio (definito da $V_{\text{O2max}}$ e la propria prestazione (definita da termini $W_{\text{max}}$). Tuttavia, all’interno dei gruppi alcuni soggetti sono risultati “non-responder”. In una seconda fase del progetto, i “non-responder” hanno partecipato a un secondo periodo allenante di 6 settimane che includeva due sessioni aggiuntive a settimana rispetto al periodo precedente. I risultati hanno mostrato che prima della fine del primo periodo di esercizio la percentuale di soggetti “non-responder” era rispettivamente del 69%, 40% e 29% nei gruppi 1, 2 e 3 (60, 120, 180 min/settimana) mentre i “non-responder” non erano presenti nei gruppi 4 e 5 (240 e 300 min/settimana) (Figura 2). Inoltre, al termine del secondo periodo di allenamento (incluse le due sessioni di allenamento sup-
training groups differing in number of weekly workouts (from 1 to 5/week session). At the end of the exercise period (6 weeks) most of the subjects improved their cardiorespiratory fitness (defined as VO2max) and their performance (defined as Wmax). However, some “non-responders” subjects were identified within the groups. In a second phase of the project, these “non-responders” participated to a second 6-week operating period which included two additional sessions per week compared to the previous one. The results showed that first of all at the end of the first exercise period the proportion of non-respondent subjects was 69%, 40% and 29% respectively in the 1, 2 and 3 groups (60, 120, 180 min/week) while non-responders were not present in groups 4 and 5 (240 and 300 min/week) (Figure 2). In addition, at the end of the second training period (including two additional training sessions) the non-responders had been reset. Thus, although there is an undeniable inter-individual variability in the response to the exercise, exercise-derived benefits are related to individual response to training and each individual need the right amount of exercise.

Similar conclusions can be drawn from another recent study.66 Sisson et al. examined predictors of VO2max non-response after aerobic exercise training in a large sample (N=464) of sedentary healthy post-menopausal women. Subjects were included in a non-exercise control or in one of three exercise treatments (4, 8, or 12 kcal/kg/wk) for six months; the dose of 8 kcal/kg per week is supposed to be what a typical, overweight, sedentary, postmenopausal woman would expend when starting an exercise program based on the NIH recommendation; the remaining two exercise treatment groups were scaled to 50% above and 50% below the 8 kcal/kg per week group (i.e., 12 kcal/kg per week and 4 kcal/kg per week, respectively). The 4 kcal/kg per week was utilized to examine whether smaller amounts of exercise than the NIH Consensus Development Panel would still provide health benefits to this population. The 12 kcal/kg per week group was designed to examine whether more exercise would translate into a proportionally greater increase in the health benefits of the population of interest. The overall predictors of VO2max non-response to cardiorespiratory training were baseline VO2max, age, and volume of training. Interestingly, those women that were younger, less fit or exercise more have greater

![Figure 2.—Variations in VO2max before and after the second exercise training period (modified from Montero et al.).](image)

Conclusioni simili possono essere tratte anche da un altro studio recente.66 Sisson et al. hanno esaminato i predittori del mancato aumento di VO2max dopo allenamento aerobico in un ampio campione (N=464) di donne in post-menopausa sane e sedentarie, che sono state suddivise in un gruppo di controllo senza esercizio o in uno dei tre trattamenti di esercizio (4, 8 o 12 kcal/kg/settimana) per sei mesi; la dose di 8 kcal/kg alla settimana dovrebbe essere quella che una tipica donna in post-menopausa, in sovrappeso, sedentaria, dovrebbe spendere quando inizia un programma di allenamento basato sulla raccomandazione NIH; i restanti due gruppi di trattamento di esercizio erano ridimensionati del 50% sopra e del 50% sotto il gruppo 8 kcal/kg per settimana (cioè, 12 kcal/kg per settimana e 4 kcal/kg per settimana, rispettivamente). I 4 kcal/kg alla settimana erano stati selezionati per esaminare se quantità di esercizio inferiore a quelle raccomandate dal NIH Consensus Development Panel avrebbero comunque fornito benefici per la salute in questa popolazione. Il gruppo 12 kcal/kg alla settimana era stato inserito per esaminare se un maggiore esercizio fisico si traducesse in una quantità proporzionalmente maggiore dei benefici per la salute della popolazione di interesse. I predittori generali della mancata risposta di VO2max all’allenamento aerobico erano il VO2max di base, l’età e il volume di allenamento. È interessante no-
odds of improving their $\dot{V}O_{2\text{max}}$ with training. The increase in $\dot{V}O_{2\text{max}}$ was especially strong in the group that exercised 50% above the current recommendation (i.e., 192 minutes/week), suggesting that volume of exercise was a significant predictor in the study. Moreover, those exercising at a level of 8 kcal/kg per week are 55% more likely to increase their $\dot{V}O_{2\text{max}}$ than participants exercising at 4 kcal/kg per week. In conclusion older, postmenopausal women interested in increasing aerobic fitness should consider increasing the total volume of exercise to increase the likelihood of reaching their goals.

In conclusion, current data suggest that current exercise prescription guidelines are fundamental references, but physicians should tailor their exercise prescription according to individual characteristics of their patients.

Sedentariness mitigates effects of physical activity

**Key Messages**

— Do not exceed the threshold of 6-8 h/day of total sitting or sedentary less than 3-4 h/day of TV viewing and reducing work time sitting by up to 4 hours per day.

— One of the strategies is to replace 30-60 minutes/day of sedentary time with light-intensity physical activity or free-living activity.

Research literature has generally shown that sedentary lifestyles are greatly influenced by modern society as cutting-edge technology has strongly impacted on human’s daily life. Nowadays transportation, workplaces, communications and domestic entertainment has created environments that encourage sedentary behaviors.67, 68

In the last decade, the number of studies focused on sedentary behavior and its potential for detrimental effects on health across the lifespan has exponential increased.69-71 These researches were necessary in order to find healthy countermeasures to reduce the global cost of sedentariness, which is estimated to be 54EUR billion per year in direct health care with an additional 14EUR billion attributable to lost productivity.72, 73 Altogether, sedentariness accounts for 1-3% of national health care costs.73, 74

A sedentary lifestyle is a major underlying cause of death, non-communicable diseases, and disability. Preliminary findings from a WHO study on risk factors suggest that sedentary life-
style is one of the ten leading causes of death and disability in the world.73 Specifically, sedentary behavior, currently defined as behaviors that involve sitting, lying or reclining positions and low levels of energy expenditure (≤1.5 metabolic equivalents) during waking hours, is now recognized as an independent risk factor and it is associated with health conditions including cardiovascular disease, obesity, type 2 diabetes and overall premature mortality.75-80 Moreover, recent evidence suggests that sedentary behavior is associated with some mental health comorbidities such as depression, and anxiety.81-84

Recent data suggest that sedentary behavior is highly prevalent in industrialized countries, with the majority of people’s time (55-69% of the day) spent in sedentary pursuits.85-87 This modern behavior is in contrast to the evolution of mankind where movement was the central selective force throughout human evolutionary history.88, 89 Stone Age humans had an energy efficiency ratio of 2.25 compared with an efficiency ratio of 3.66 for modern humans.90 Moreover, physical activity level among subsistence-level human populations approximates 3.2, while among representative humans living in contemporary society, the physical activity level is approximately 1.67.91 This increase in energy efficiency and decrease physical activity level determined a negative consequence with the proliferation of health issues.

Literature established that low levels of physical activity lead to an increased risk of developing several chronic diseases as well as all-cause mortality.92 Recently, sedentary behavior has been also listed to be associated with the aforementioned disorders. Formerly, the health risks associated with a sedentary lifestyle were thought to be a result of insufficient moderate and vigorous physical activity.93

However, new evidence suggested that sedentary behaviors emerging as a potentially important independent factor in the relationship between lifestyle and health in particular in cardiometabolic risk profiles.94-97 Research on the health consequences of certain sedentary behaviors and excessive sedentary time has increased in recent years. Indeed, indications on sedentary behavior have been introduced in public health guidelines for adults and recommend minimizing time spent sedentary or sitting without specifying how many hours/day of sitting might be harmful.98-101 It has been shown that high risk mortality above 10 hours/
day of time of sedentary time and already starts to increase above 7.5 hours/day of sedentary lifestyle. These results highlight the importance to insert a set of quantitative specific sedentary behavior guidelines with a threshold of 6-8 h/day of total sitting or sedentary, less than 3-4 h/day of TV viewing and reducing work time sitting by up to 4 hours per day, above which risk for several important health outcomes increased more rapidly. Presently, epidemiological evidence suggests the adverse relationship between high volumes of sedentary time have and health outcomes that may be independent of a person’s physical activity levels. Indeed it was confirmed that despite meeting the minimum physical activity recommendations with high volumes of sedentary behavior is associated with an increased risk of cardiometabolic disease and all-cause mortality in adults. For instance high levels of moderate and vigorous physical activity (>7 hours/week) and watching television for seven or more hours per day was associated with a double the risk of cardiovascular mortality compared to those who watched <1 hour/day of television.

Although in existing guidelines moderate and vigorous physical activity is one of the key non-pharmacological strategy to reduce health risk by itself is insufficient to eliminate or attenuate the risks of sedentary behavior and only unrealistically large volumes of moderate and vigorous physical activity (about 60 to 75 minutes per day) appear to be needed to get health benefits and eliminate the increased risk of death associated with high sitting time or sedentary lifestyle. One of the strategies is to replace 30.6 minutes/day of sedentary time with light-intensity physical activity or free living activity to decrease health risks. Another strategy is convert 10 minutes of sedentary life with 10 minutes of moderate and vigorous physical activity. On the basis of these results, when trying to reduce sedentary behavior, not only moderate and vigorous physical activity should be targeted but a more integral public health recommendation might be to find a healthy balance between, sitting, standing, regular short bouts, introduce free living activity or light intensity physical activity throughout the day for minimizing the likely harmful metabolic effects of high volumes of sedentary behavior throughout the day. The evolution of the 20th century has been an improvement of our specificare quante ore/giorno in posizione seduta potrebbero essere considerate dannose. È stato dimostrato che la mortalità raggiunge elevati livelli di rischio al di sopra delle 10 ore/giorno di sedentarietà ed inizia ad aumentare già al di sopra delle 7,5 ore/giorno. Questi risultati evidenziano l’importanza di inserire una serie di linee guida quantitative specifiche sul comportamento sedentario con una soglia di 6-8 ore al giorno di seduta totale o sedentarietà, meno di 3-4 ore al giorno di visione della TV e ridurre il tempo di lavoro seduto a 4 ore al giorno, soglie al di sopra delle quali il rischio di sviluppare diverse patologie aumenta esponenzialmente.

Attualmente, l’evidenza epidemiologica suggerisce una relazione inversa tra elevati tempi sedentari e salute, la quale potrebbe essere indipendente dai livelli di attività fisica praticati da una persona. È stato confermato che, nonostante il rispetto delle raccomandazioni minime sull’attività fisica, elevati volumi di sedentarietà sono associati ad un incremento di rischio di malattie cardiometaboliche e mortalità generale negli adulti. Ad esempio, livelli elevati di attività fisica moderata e vigorosa (>7 ore settimanali) e guardare la televisione per sette o più ore al giorno sono stati entrambi associati ad un doppio rischio di mortalità cardiovascolare rispetto a coloro che guardavano la televisione <1 ora/giorno.

Sebbene nelle attuali linee guida un’attività fisica moderata e vigorosa sia una delle strategie non farmacologiche chiave per ridurre i rischi sulla salute, questa da sola non è sufficiente per eliminare o attenuare tutti i rischi legati alla sedentarietà e solo grandi (e irrealistici) volumi di attività fisica moderata e vigorosa (circa 60-75 minuti al giorno) sembrerebbero essere necessari per ottenere benefici per la salute ed eliminare il rischio aumentato di morte associato a un elevato tempo seduto o di stile di vita sedentario.

Una delle strategie è quella di sostituire 30-60 minuti/giorno di tempo sedentario con attività fisica di bassa intensità o attività quotidiane per ridurre i rischi per la salute. Un’altra strategia è convertire 10 minuti di vita sedentaria con 10 minuti di attività fisica moderata e vigorosa. Sulla base di questi risultati, quando si cerca di ridurre il comportamento sedentario, non solo si dovrebbe mirare ad un’attività fisica moderata e vigorosa, ma una raccomandazione più integrata sulla salute pubblica potrebbe essere quella di trovare un sano equilibrio tra, seduto, in piedi, scatti brevi e regolari, introdurre attività fisiche quotidiane o di bassa intensità per ridurre al minimo i probabili effetti metabolici dannosi di elevati volumi giornalieri di sedentarietà.
XXI secolo è stata un miglioramento delle nostre condizioni di vita. La sfida globale del XXI secolo è quella di ridurre gli stili di vita sedentari come priorità di salute pubblica in tutto il mondo al fine di migliorare la salute della popolazione e ridurre l’incidenza di malattie croniche. La consapevolezza dell’onere economico del comportamento sedentario potrebbe motivare i responsabili politici ad affrontare questo fattore di rischio e presentare i vantaggi della prevenzione dello stile di vita sedentario.117 Per trovare una soluzione al problema, è interessante comprendere la relazione tra la durata totale del comportamento sedentario quotidiano e le associazioni tra i diversi modelli di sedentarietà. Linee guida cliniche e di salute pubblica per l’attività fisica sono in atto da quasi due decenni; tuttavia specifiche strategie di intervento con raccomandazioni relative ai modelli di comportamento sedentario nelle linee guida per la salute pubblica è ancora un punto mancante. Questo suggerisce come le precedenti linee guida o raccomandazioni per il miglioramento della salute, anche se ancora rilevanti, potrebbero non essere sufficienti nel nuovo “mondo sedentario.”

Importanza delle attività di vita quotidiana

MESSAGGI CHIEVE
— Le attuali linee guida per l’attività fisica non tengono conto delle attività della vita quotidiana;
— L'attività fisica nel tempo libero e nel lavoro ha un impatto positivo sulla salute e dovrebbe essere presa in considerazione quando viene prescritta attività fisica.

Molti studi osservazionali hanno dimostrato che un importante fattore di rischio per la morbilità e la mortalità prematura è la mancanza di attività fisica.118-120 Questi dati hanno portato le istituzioni e i governi a definire raccomandazioni per la corretta quantità di attività fisica che ogni soggetto dovrebbe svolgere ogni giorno o ogni settimana nel suo tempo libero. Tuttavia, è noto che anche il dispendio energetico o l’attività fisica svolta durante le attività lavorative è importante.121 In metà degli anni ’50, Morris et al.118 riferirono che i conducenti di autobus di Londra rispetto ai controllori erano ad aumentato rischio di malattia coronarica e dichiararono che: “The general hypothesis may therefore be restated in causal terms that physical activity of work is a protection against coronary ischemic heart disease. Men in physically active jobs have less coronary heart disease during middle age, what disease they have is less severe, and they develop it later.”118
melen et al., as well as Jonsson and Åstrand\textsuperscript{7} who demonstrated the existence of an association between heavy physical work and higher cardiorespiratory fitness in young men and women.\textsuperscript{122, 123} Another paper from Kruger et al., confirmed these findings.\textsuperscript{124} Data examination from National Physical Activity and Weight Loss Survey (NPAWLS) indicated that adults engaged in physically demanding work join more physical activity lifestyle than those who sit or stand at work. Vice versa those who engage in a relatively low level of occupational physical activity (OPA) are less active off work than those who do heavy labor.

Up to date, exercise prescriptions guidelines do not take into account the amount of physical activity performed by subjects/patients during work, although several studies have confirmed a consistent relationship between Occupational Physical Activity (OPA) and chronic diseases independently of Leisure Time Physical Activity (LTPA), being the combination of LTPA and OPA more protective.\textsuperscript{125}

\textbf{Italian recommendations for prescribing physical activity to healthy adults}

\textit{General overview}

Recommendations for physical activity and for limiting the amount of time being sedentary are fundamental for developing a comprehensive strategy aimed to safeguard the health in all adults aged 18 to 65 years. The wide range of activities required for various health outcomes was also acknowledged, with health benefits seen as developing across a continuum from light to vigorous effort.

In adults, physical activity includes not just physical exercise but also incidental activities or activities of daily living, transportation, occupational, recreational, household chores, sports, family and community activities. Starting for these, several organizations worldwide have created physical activity guidelines (Table IV) on the basis of an overwhelming body of evidence. However, it is necessary to develop personalized “exercise prescription” for all individuals and combine different type of activities, such as cardiorespiratory fitness activities, muscle strengthening fitness activities, motor skills activities, flexibility and avoid a sedentary life to promote and obtain a substantial health improvement. For the purpose of our work, these results were confirmed by Tam-melin et al., as well as Jonsson and Åstrand\textsuperscript{7} who demonstrated the existence of an association between labor fisico pesante and maggiore idoneità cardiorespiratoria in giovani uomini e donne.\textsuperscript{122, 123}

Un altro articolo di Kruger et al. ha confermato questi risultati.\textsuperscript{124} L’analisi dei dati raccolti con il National Physical Activity and Weight Loss Survey (NPAWLS) ha indicato che gli adulti impegnati in lavori fisicamente impegnativi hanno uno stile di vita più attivo rispetto a coloro che stanno seduti o in posizioni fisse al lavoro. Vice versa, coloro che svolgono un livello relativamente basso di attività fisica occupazionale (occupational physical activity, OPA) sono meno attivi rispetto a quelli che svolgono lavori pesanti.

\textbf{Linee guida italiane per la prescrizione dell’attività fisica per la salute}

\textit{Introduzione generale}

Le raccomandazioni per l’attività fisica e per limitare la sedentarietà sono fondamentali per lo sviluppo di una strategia globale volta a salvaguardare la salute di tutti gli adulti dai 18 ai 65 anni. È stata anche riconosciuta la vasta gamma di attività richieste per vari risultati sulla salute, con vari benefici per la salute che si sviluppano attraverso un continuum dall’allenamento di intensità leggera a vigorosa.

Negli adulti, l’attività fisica comprende non solo l’esercizio fisico, ma anche le attività accessorie o le attività della vita quotidiana, gli spostamenti, le attività lavorative, ricreative, le faccende domestiche, lo sport, le attività familiari e comunitarie. A partire da questi, diverse organizzazioni in tutto il mondo hanno creato linee guida per l’attività fisica (Tabella IV) sulla base di una vasta serie di prove. Tuttavia, è necessario sviluppare una “prescrizione dell’esercizio” personalizzata per tutti gli individui e combinare diversi tipi di attività, come attività di fitness cardiorespiratorie, attività di rafforzamento muscolare, esercizi per le abilità motorie, allenamento della flessibilità ed evitare una vita sedentaria per promuovere e ottenere un miglioramento sostanziale sulla salute. Ai fini
in the cardiorespiratory fitness activities we grouped relative levels in three main categories: the first category is the sedentary population, the second category is the population moderately active that reports being somewhat active, and the third category is the active/fit population. A similar approach was utilized for muscle strength prescription, in which we grouped relative levels in three main categories: the first category is the powerless population, the second category is the intermediate population, and the third category is the powerful population. No categorization was performed for prescription of flexibility and balance.

Exercise prescription for cardiorespiratory fitness

Rhythmic, aerobic activity of at least light, moderate and vigorous intensity that involves large muscle groups and requires little skills to perform is recommended for all adults to improve health and cardiorespiratory fitness. In our perspective the amount of exercise should be the same recommended by worldwide institutions and government: 300 min/week of light intensity exercise (such as walking), 150 min/week of moderate intensity exercise (for example brisk walking) or 75 min/week of high intensity exercise (running or jogging) (Table IV). According to physiological responses to aerobic exercise, subjects should be divided into three categories (sedentary, moderately active, trained) and exercise prescriptions should be different for each group (Table V). The recommended amount of exercise within this domain may be accumulated in one continuous exercise session or single bouts of 10 min over the course of a day and workload should be progressively increased.126, 127

The above-mentioned recommendations for physical activity prescription should be corrected according to non-structured amount of physical activity performed by subjects and taking into consideration sedentariness. Thus, we propose two correction factors as suggested in Table VI. These correction factors should be applied only when total amount of exercise performed during leisure-time matches the prescribed amount according to guidelines.

Exercise prescription for muscular strength

Muscle strengthening activities are the most popular form of exercise for developing muscu-
Loskeletal strength, hypertrophy, muscle power and endurance with the goal of enhancing athletic performance, preventing injuries and maintaining a healthy lifestyle. Muscle-strengthening activities include a progressive weight-training program with continuum of isolated machine-based to multi-joint free-weight, exercises weight bearing calisthenics, and weightlifting movements. The rate of progression in an exercise weight program depends on the individual’s health status, training responses and can be implemented through manipulation of muscle strength training variables such as intensity, volume, frequency, inter-set rest period, contraction type and time-under tension.128-132 The potenza e della resistenza muscolare con l’obiettivo di migliorare le prestazioni atletiche, prevenire gli infortuni e mantenere uno stile di vita sano. Le attività di rafforzamento muscolare includono un programma progressivo di allenamento con i pesi con un continuum di macchine isolate multi-articolari senza peso, esercizi di allenamento con pesi e sollevamento pesi. Il tasso di progressione in un programma di forza dipende dallo stato di salute dell’individuo, dalle risposte all’allenamento e può essere implementato attraverso l’utilizzo di variabili dell’allenamento della forza muscolare come intensità, volume, frequenza, periodo di riposo, tipo di contrazione e tempo di contrazione.128-132 Il principio di individualizzazione dell’allenamento
È fondamentale nella progettazione dei protocolli di allenamento di forza al fine di ottimizzare gli adattamenti.\textsuperscript{133, 134} Il metodo di individualizzazione dell’allenamento della forza si basa sulla prescrizione del carico come percentuale di una ripetizione massima (1RM) o valutazione dello sforzo percepito (RPE) per aumentare i carichi di lavoro dopo un periodo di adattamento.\textsuperscript{135, 136}

L’attività di forza deve essere eseguita sui principali gruppi muscolari con almeno 48 ore tra le sedute per lo stesso gruppo muscolare. Il regime di contrazione muscolare deve essere concentrico, eccentrico e isometrico con una velocità e una durata di esecuzione da bassa a moderata.\textsuperscript{137-139} Individualizzato training program must be integrated in order to compensate the muscle groups that are not used during occupational and leisure time physical activity. Individualized training program according to individual characteristics are reported in Table VII.


det describe the principle of individualization of the program and the method of individualizing resistance training.

Exercise prescription for flexibility and motor skills

The inclusion of joint range of motion or flexibility activities as part of an adult’s physical activity routine may enhance mobility and functional independence.\textsuperscript{140}

The main flexibility activity is stretching, and it should be performed at least 2-3 times a week in all categories of people. This type of activity is generally incorporated into the pre-activity routine or even as a post activity.

\begin{table}[h]
\centering
\begin{tabular}{|l|l|}
\hline
\textbf{Category} & \textbf{Prescription} \\
\hline
Powerless & Adults should perform muscle strength activities at least 1-2 times per week.  
Prescription should start from muscular endurance (load of 67\% or less of 1RM) exercises performed for 12 or more repetitions of 2-3 sets.  
Exercises should be separated by rest intervals of about 60-120 s.  
After 6-8 weeks, muscle hypertrophy (67-85\% 1RM) or muscular power training (80-90\% 1RM), consisting in 1-3 repetitions of 3-6 sets with rest periods of 2-4 minutes, can be introduced. \\
Intermediate & Adults should perform muscle strength activities 2-3 times a week.  
Prescription should start from muscle hypertrophy (67-85% 1RM) or muscular power training (80-90\% 1RM or <60\% 1RM), consisting in 1-3 repetitions of 3-6 sets with rest periods of 2-4 minutes.  
After 6-8 weeks maximal strength (85\% or more of 1RM), consisting in 6 or less repetitions of 2-8 sets per muscle group with rest intervals of short <60 s to moderate 60–120 s, can be introduced. \\
Powerful & Adults should train muscle strength activities 3-4 times a week.  
Use a split routine where workouts are divided up by muscle groups.  
Muscle hypertrophy (67-85% 1RM) or muscular power training (80-90\% 1RM or <60\% 1RM), consisting in 3 repetitions of 3-6 sets with rest periods of 2-4 min.  
Maximal strength (85\% or more of 1RM), consisting in 6 or less repetitions of 2-8 sets per muscle group. Long-duration rest intervals >2 min are required to maximize gains in muscular strength. \\
\hline
\end{tabular}
\caption{Muscle strengthening activity prescription for powerless, intermediate and powerful individuals.}
\end{table}
Cool down. Flexibility exercises should be repeated 2-4 times to accumulate a total of 12-60 s of stretching for each flexibility exercise. Exercising should involve the major muscle and joint districts, also by changing the technique of muscle stretching (Table VIII). Several authors observed an individualized response to stretching, therefore stretching programs may need to be individualized.142

Motor skills activities

Motor skills training programs are often implemented with the aim of optimizing performance, preventing injury or providing rehabilitation. Motor skills exercises are a multi-intervention activity that incorporates balance, coordination, gait, agility, and proprioceptive training. Currently it is unclear whether a single intervention or combination of various exercises is primarily responsible for the training effects. This type of activity is generally incorporated into the pre-activity routine. Dose-response relationships in motor skills activities confirm that they should be performed at least 2-6 times a week with routines of a single training session of 11-15 min of duration (Table IX) (Supplementary Digital Material 1: Supplementary Table I).143-145

Conclusions

The importance of physical activity for well-being is well established and the development of a personalized “exercise prescription” for all individuals is fundamental. Individual prescrip-
tions should combine different type of activities, aimed to improve cardiorespiratory fitness, muscle strength, flexibility and motor skills. Moreover, activities performed during leisure time or at work as well as the sedentary behavior should be taken into consideration when an individualized exercise prescription is administered. In this manuscript we summarized the exercise prescription strategy utilized by Italian institutions to safeguard the health in all adults aged 18 to 64 years. In the future, we hope that this suggested approach will be adopted and confirmed by scientific data.

References/Bibliografia


Conflicts of interest.—The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.


Supplementary data.—For supplementary materials, please see the HTML version of this article at www.minervamedica.it