

Erasmus Plus Programme

KA 2 Strategic Partnerships for Adult Education

**“EDUCATION - THE CHALLENGE OF THE LATER
YEARS”**

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INTELLETTUAL OUTPUT 3

CHALLENGE FOR LEARNERS

Sinergia società Cooperativa Sociale

ITALY

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Hello!! This is Super Granny and Super Grandpa!!

Today we would like to talk about food and physical activity, the most important aspects for being in good health!!

Follow us and you will find out useful and interesting information...let's go!!!



Introduction

*“A healthy beggar is happier than an ailing king”
“Nine-tenths of our happiness depends upon health alone”*

A. Schopenhauer

Health is an essential condition for a happy life!

The following rule is always valid: if someone is healthy, he will be happy, whether he/she is young or old!

A correct diet has a positive influence on health and, therefore, on the quality of life. This is true in particular for the elderly, whose nutrition needs are linked to age.

At the same time, physical exercise represents a second fundamental factor to take into consideration for the health of the elderly. Not only does the lack of exercise affect the body's functional abilities, it also affects health in general.

Therefore, the fundamental topics to be addressed in order to deal with the health of the elderly are:

1. **Health and nutrition**
2. **Health and physical activity**

The present document is addressed to people over 65 and aims at providing information and useful advice to face a very important phase of life in good health.

Health problems and ailments are not just the result of ageing, but also of the **bad health and nutrition habits of an entire life**: correcting those habits is **fundamental for facing and preventing the diseases** affecting old people.

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Topic 1 Health and Nutrition

What are the essential elements of a healthy diet?

WATER



MACRONUTRIENTS



MICRONUTRIENTS



FIBERS



WATER

The natural daily needs of *water* is 30 ml/Kg of body weight or 1 ml/kcal absorbed.

Therefore, **1,5 l** of water should be absorbed **through beverages**, and the remaining **half liter through food**.

In old people, the risk of dehydration stems from the reduced stimulus of thirst and the reduced kidney capacity to concentrate urine.

Particular attention has to be paid with respect to sick people in order to guarantee a proper water balance between what is ingested and what is eliminated.



Consume food rich of water (fruits, vegetables) and drink (infusions, tea, juices etc.)...even if not thirsty!!!!

MACRONUTRIENTS

Among macronutrients, *proteins* can have different origins: animal-based (meat, fish, eggs, milk, cheese) or plant-based (legumes, such as lentils, beans, peas, fava beans, soy).

The protein need is of **1,1 g/Kg per day**, slightly higher than the protein need of adults because in old people there is lesser use of proteins due to digestive and metabolic problems.

Protracted reduction in protein assimilation can lead to tissue wearing, anemia, and a general reduction in the effectiveness of the immune system.



Grain cereals (oat, rye, buckwheat, quinoa, amaranth) used in soups and broths, have high protein qualities, at the same time allowing the reduction in the assimilation of animal-based proteins .



Lupin beans represent an important source of plant proteins for their high nutritional value, digestibility, cholesterol-lowering effect and hypoglycemic function.

Lipids, generally known as **fats** (coming from types of food such as oil, lard, eggs, butter, cheese, margarine) represent an important reserve energy source, as 1 g generates 9 Kcal. Lipids should cover 25% of the daily need of calories. Lipids of **plant origin** are to be preferred, especially for old people.

Carbohydrates provide 4Kcal/g. They represent the most immediate energy source and they can be divided into simple (sugar, honey, jam) and complex carbohydrates (bread, pasta, rice, potatoes). Carbohydrates provide 50/60% circa of the daily calories need. It is preferable to opt for complex carbohydrates and reduce the simple ones.

MICRONUTRIENTS

Among micronutrients, **vitamins** are fundamental as they cannot be produced by the body. A proper intake of vit B 6, B 12, folic acid, vit D is very important. Ageing does not entail higher vitamin needs: it is however necessary to avoid some diet mistakes (such as overcooking, use of preserved food) common for people over 65 and accentuated by the alteration of digestive and metabolic functions.



The content of iron in vegetables (chickpeas, beans, lentils, rocket, radicchio, whole cereals) and the content of calcium in legumes, turnip, rocket, chicory and water are also not to be underestimated.

Minerals (sodium,, potassium, magnesium, calcium) should be ceaselessly reintegrated in the organism, since they are continuously eliminated through sweat, urine and faeces. Calcium is always to be kept in check (especially in women) since it causes osteoporosis, while potassium can lead to the reduction of the muscle tone and cardiac rhythm. In addition, is used in high quantity, sodium constitutes a risk factor for hypertension.



During summer, exposing your face, hands, and forearms to the sun helps providing the body with vitamin D. Vit D has also anti-cancer, immunomodulatory, neuroprotective, and anti-depressive effects

FIBERS

Fibers are substances without energy or nutrition value. They are important to regulate such body functions as metabolism and intestinal regularity. Fibers are instrumental in avoiding constipation, which is facilitated by a sedentary lifestyle and the reduced intake of liquids. It is therefore important to eat fruits, vegetables, legumes and whole cereals.

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*It is recommended to eat:
pears, dried plumes,
artichokes, spinach, beans,
aubergines*

YOUR CORRECT DAILY DIET

Nutrients' optimal daily distribution:

| NUTRIENTS | DAILY NEED IN % |
|--------------|-----------------|
| PROTEINS | 15% |
| FATS | 25% |
| CARBOHYDRATS | 60% |

Therefore, the diet will include:

- Milk and dairy products;
- Lean meat, eggs and legumes;
- extra virgin olive oil;
- fresh seasonal fruits and vegetables.
-

It is recommendable that the daily diet be divided in **5 meals!**

Including a half-morning and half-afternoon snack with:



fruits



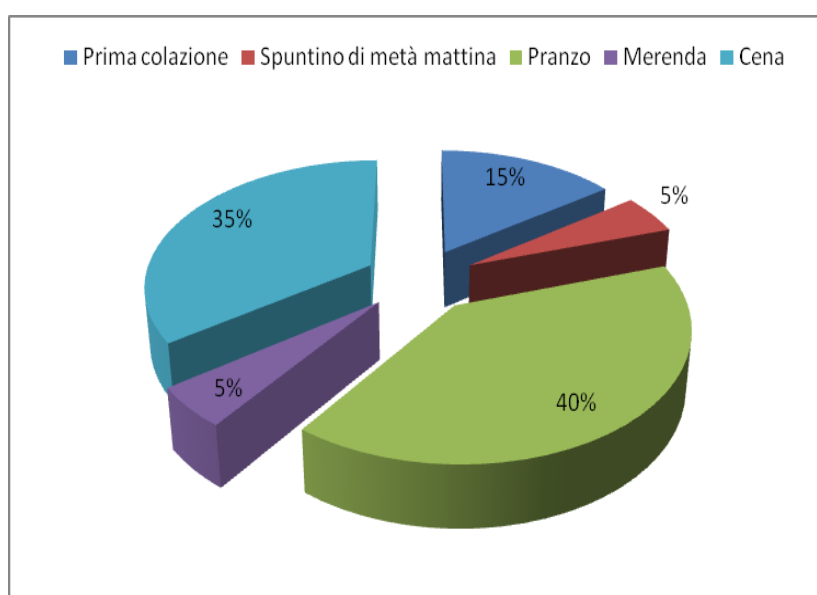
tea



yogurt

Optimal daily energy distribution over 5 meals:

| MEAL | DAILY NEED IN % |
|--------------------|-----------------|
| Breakfats | 15% |
| Half-morning snack | 5% |
| Lunch | 40% |
| Tea break | 5% |
| Dinner | 35% |



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Topic 2 WELLBEING AND PHYSICAL ACTIVITY

Daily physical activity is the real secret to wellbeing, since it:

- improves cardiovascular efficiency
- controls body weight
- improves muscle and bone efficiency
- reduces depression and limits insomnia
- keeps glycaemia under control
- reduces the risk of cancer

A body not used to physical activity becomes unable to withstand even minimum efforts; lack of movement deteriorates the functionality of many organs and apparatus, favouring the insurgence of different diseases, such as heart attack, stroke, arterial hypertension, diabetes, osteoporosis.

Constant physical activity has positive effects on many organs, besides having also applications treatment of some chronic diseases. On the basis of the type of pathology, there are different kinds of more or less appropriate workouts. These are selected according to: intensity, duration, frequency, and methods of execution.

The two main groups of physical activity are: **aerobic** (duration) e **anaerobic** (power).

Aerobic activities are prolonged workout exercises of light/moderate intensity, stimulating circulation and respiration.

Anaerobic activities are workout exercises characterised by short duration and high intensity, stimulating muscles and the skeleton.

Most of the most common physical activities have mixed characteristics.

In 2010, the World Health Organisation (WHO) published the new guidelines on physical activity for health and wellbeing. The document indicates the frequency, duration, intensity, type and quantity of the activity needed to prevent chronic diseases.

In people over 65, physical activity takes place in leisure or occupational activities, bricolage, active movements (by foot, using stairs, by bike), amateur sports, and physical workout programmes.

The WHO recommends:

- **150 minutes/week** of moderate aerobic activity or **75 minutes** of intense or similar activities, in sessions of at least 10 min. at a time.
- Workout drills aimed at **strengthening the main muscle groups** at least twice a week.
- Those with motor problems are recommended to perform drills for **improving balance** at least three times per week.

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- Those who cannot reach the recommended levels are advised to be as active as possible according to each physical conditions.

Good Practices:

The WHO's "Global Recommendations on Physical Activity for Health" pointed out two countries that appropriately promote and encourage physical activity for the elderly: Australia and Canada.

Australia:

- *Think of physical movement as an opportunity, not as an inconvenience.*
- *Be active everyday anyway you can.*
- *Put together at least 30 minutes of moderate physical activity, preferably every day.*
- *It is important to use protection devices to maximise security and reduce the risk of injuries during physical activity.*

Canada:

- Integrate physical activity in your daily routine.
- Carry out the activities you are already doing, but more frequently.
- Go everywhere on foot anytime you can.
- Start slowly by stretching.
- Find the activities you like.

HOW TO MEASURE PHYSICAL ACTIVITY?

A simple evaluation of the intensity of the physical effort is made on the basis of the MET (metabolic equivalent). 1 MET is the rhythm of energy consumption of the human body at rest. It corresponds to a consumption of 3.5 ml of O₂ per kg per minute (1 Kcal/kg/h circa):

- Light intensity activities request an effort 1 to 3 times higher than rest = 1,0 - 2,9 MET
- Moderate intensity activities are conducted at a level 3 to 6 times higher than rest, namely = 3,0 – 5,9 MET
- High intensity activities request an effort more than 6 times higher than rest = / > 6 MET

Other methods of measuring are: the pedometer (portable device sensitive to acceleration that can be worn all day or for determined walking sessions) or cardiac frequency (it can be tracked by portable devices or counting heartbeats on the wrist; the max CF is about 220)

There are simple methods to self-assess the intensity of physical activity, such as:

Walk and talk test.

How does it work?

If while walking

- you can sing: the effort is too light and you need to speed up;
- you can speak, but cannot sing: the effort is of moderate intensity;
- you cannot speak: the effort is too intense and you need to slow down.



Which everyday activities can be considered of slow or high intensity?

Here are some examples:

| | |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| low | walking slowly |
| | washing dishes, ironing, dusting |
| | doing do-it-yourself, grocery shopping, doing manual work |
| | watering the garden |
| | playing bocce, pool, bowling, ping pong, dancing |
| moderate | walking quickly |
| | washing the car or windows |
| | using the vacuum cleaner |
| | gardening, sweeping leaves |
| | doing aerobics |
| | biking or swimming, skiing, playing with a frisbee, sailing boating, playing badminton, playing golf |
| intense | walking in the mountains |
| | spading, moving furniture |
| | jogging, swimming hard, rope jumping, playing football, playing volleyball (and most of team sports with a ball), playing fighting sports, playing tennis, squash, hiking |

Examples of workout exercises for the elderly



Exercise 1: Nutrition



BREAKFAST

- Cows' milk or plant-based milk (soy, almonds, oat , rice)
- Or cows' or soy's yogurt
- Coffee or barley coffee or tea or cereal coffee
- Toasted bread slices or biscuits (better if whole) or bread (better if toasted) (or corn flakes)
- Dried fruits (up to 10-15 g of dried fruits: walnuts, almonds, pistachios, pine nuts)

It is important to know that:

- Plant-based milk is suggested in case of lactose intolerance
- Coffee: in moderate quantities it has several properties, such as anti-diabetes, hepato-protective, stimulating gastrointestinal functionality, neuro-protective (M.A M.P), anti-cancer (if tolerated, and if there are no CV pathologies and if no use of drugs active on the nervous system is involved)

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- Tea: a constant consumption reduces the insurgence of strokes, cerebrovascular diseases, type-2 diabetes, cardiovascular diseases, cancer and kidney-related ailments.
- Dried fruits: rich in vitamins, minerals, essential fats, and have positive effects on feeling full, and reduce the risk of cardiovascular diseases, cancer, etc. (provided no allergies are involved)

Note: it is advisable to add a spoonful of wheat germ (rich of vitamins, proteins, essential fats). Limiting white sugar is also recommended: it would be better to use honey molasses/fructose.

LUNCH

- Pasta or rice (possibly whole)
- Other whole grains: barley, hulled wheat, oat, rye, buckwheat, quinoa, millet, amaranth)
- Bread (better if whole and toasted). Unleavened bread if intolerant to yeast.
- Animal proteins (meat, fish, eggs, cheese) or plant-based proteins (legumes)
- Raw vegetables (preferably at the beginning of the meal) possibly with chunks of fruits
- Cooked vegetables
- Plant-based fats (extra-virgin olive oil, corn, sunflower, flaxseed oil) or sesame seeds.

It is important to know that:

- Whole grains: high quantity of proteins minerals, fibers
- Grain cereals: oat, rye, buckwheat, quinoa, millet, amaranth. Used in broths and vegetable soups, they have a high protein level (allowing the reduction in the use of animal proteins).
- Animal proteins: it is recommended to keep the consumption of red meat, sliced meat, eggs and cheese under control.
- Plant-based proteins: legumes, and also soy and others (tofu, tempeh).

DINNER

- Pasta or bread (preferably whole) in reduced quantity
- Other grain cereals
- Animal or plant-based proteins
- Raw/cooked vegetables

After dinner: possibly 1 glass of milk or hot infusion (to aid sleep: lemon balm, lavender, camomile)

SNACKS

It is preferable that the daily diet be divided in 5 meals, with the insertion at half-morning and half-afternoon of a snack containing:

- fresh fruits (or fruits juices)
- tea or infusion with toasted sliced bread
- yogurt (milk or di soy-based)

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Exercise 2: Physical Activity – Improving Circulation and Strengthening Articulations

NOTES:

- Equipment: chair, tennis ball
- 10 exercises (1 round)
- 30" workout - 10" pause
- From 40" to 60" pause between rounds
- 2/3 rounds every other day

EXERCISES:

1. 10 CIRCLINGS WITH THE BALL UNDER YOUR RIGHT FOOT
2. 10 CIRCLINGS WITH THE BALL UNDER YOUR LEFT FOOT
3. 10 SLIDINGS BACK AND FORTH WITH THE BALL UNDER YOUR RIGHT FOOT
4. 10 SLIDINGS BACK AND FORTH WITH THE BALL UNDER YOUR LEFT FOOT
5. 10 LEG EXTENSIONS WITH THE BALL ON YOUR FEET
6. 10 CONTROLLED INTERNAL AND EXTERNAL FOREARM ROTATIONS WITH YOUR RIGHT ARM FLEXED AT 90 DEGREES
7. 10 CONTROLLED INTERNAL AND EXTERNAL FOREARM ROTATIONS WITH YOUR LEFT ARM FLEXED AT 90 DEGREES
8. 10 CIRCLINGS WITH THE BALL IN THE PALM OF YOUR RIGHT HAND WITH ALTERNATE ROTATION
9. 10 CIRCLINGS WITH THE BALL IN THE PALM OF YOUR LEFT HAND WITH ALTERNATE ROTATION
10. 110 BALL THROWS FROM ONE HAND TO THE OTHER
11. 110 CONTROLLED BALL FORWARD PASSES FROM THE RIGHT TO THE LEFT HAND
12. 110 CONTROLLED BALL PASSES BEHIND THE BACK FROM THE RIGHT TO THE LEFT HAND
13. 10 RIGHT EXTENDED ARM FRONT LIFTS
14. 10 LEFT EXTENDED ARM FRONT LIFTS
15. 10 LIGHT ALTERNATE FEET LIFTS WITH THE BALL BETWEEN KNEES.

Exercise 3: Physical Activity – Improving posture and balance

A. Upright position with your hand against a chair

- Place the other hand on the upper side of your hip and left your leg sideways
- Make sure your hip is still.
- Repeat 10 times.
- Repeat the drill with your other leg.
- If possible, add 1-2kg weight to your ankle and make sure you can lift it with no particular difficulty.

Advantages: It reinforces your hips and improves your balance.

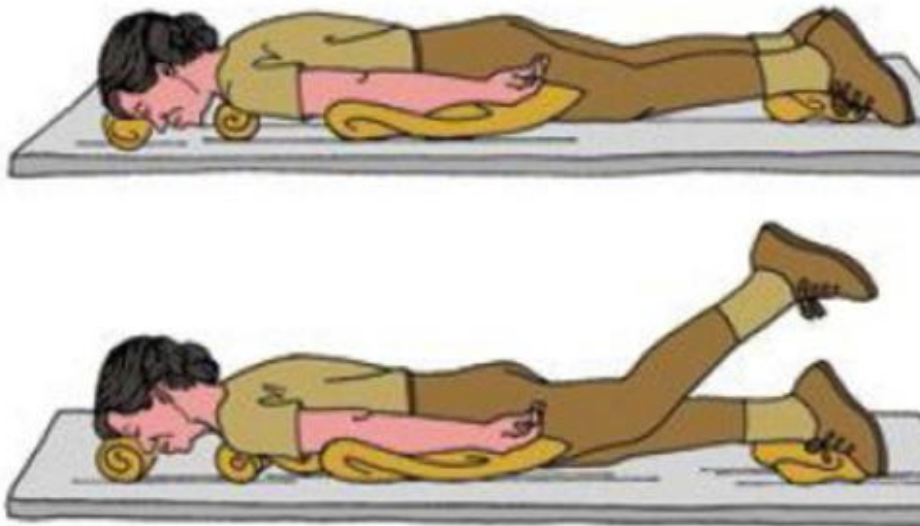


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B. In prone position with arms along your hips.

- Place some towels under your forehead and shoulders, and a towel or pillow under your abdomen.
- Slightly bend your right leg and lift your thigh from the floor.
- Keep your foot relaxed.
- Repeat 10 times per side.
- If possible, add some weight to your ankle
- If adding weight causes back pain, try and add another pillow under your abdomen.

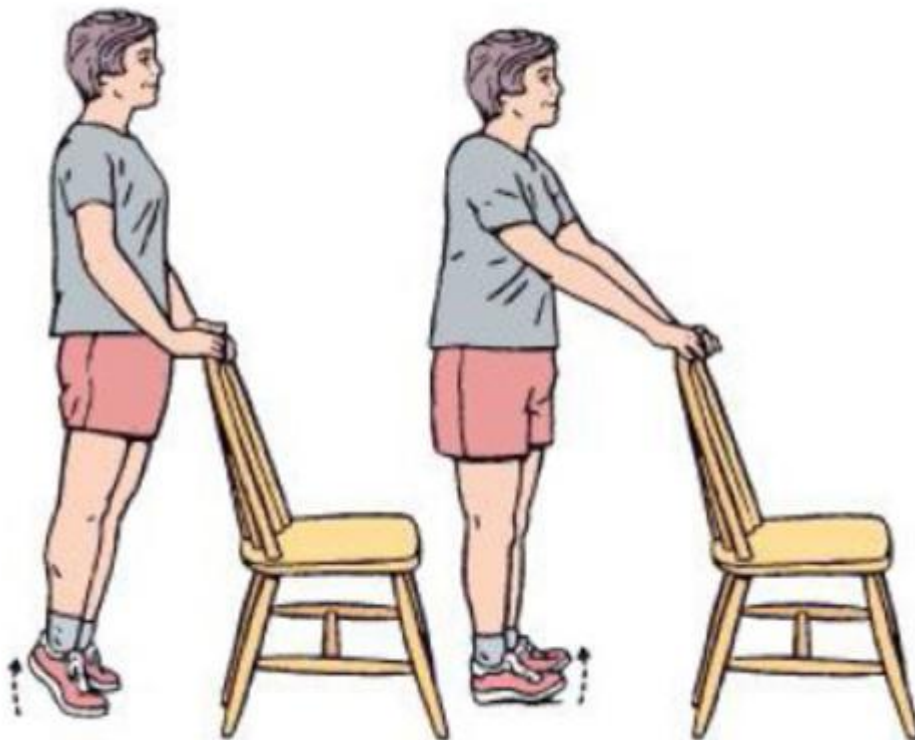
Advantages: it reinforces your lower back and gluteus muscles. It stretches your flexor muscles and the front part of your thighs.



C. Upright position holding your balance with a chair without flexing your chest and knees.

- Raise on the tip of your feet and get back on your heels.
- Repeat 10 times.
- Raise on the tip of your feet staying firm on your heels; get back on the tip of your feet
- Repeat once a day.

Advantages: It reinforces the lower part of your legs and helps improving your balance.



D. Lean with your back against a wall.

- Keep your feet leveled with your shoulders.
- Lean with your gluteus, palms and shoulders against the wall.
- Move up and down the wall bending your knees.
- Keep your back, shoulders and abdomen flat against the wall.
- Repeat 10 times.

Advantages: it strengthens your thighs, abdomen and back, improving the posture of your back.



Integrated workshop– Nordic walking and healthy snack



Nordic walking is a walking technique, which integrates the use of walking sticks in the natural walking way, taking inspiration from the classic cross country skiing's technique.

Nordic walking can be practiced everywhere, in city parks, in the mountains, on seashores, in woods trails, etc. It is a great way to practice sport close to nature.

The use of sticks while walking implies a series both physical and mental benefits, which are determining the current success of this sport.

Indeed, nordic walking has a significant effect favouring the use of nearly the 85% of musculature, thus contributing to the consumption of 40% circa more than classic walking. All this without putting on an excessive load on such articulations as hips and knees. As a result, nordic walking is generally recommended for those people with articulations problems and for those in the process of recovering from traumas and overweight people. It is therefore recommended also for old people.

The advantages of nordic walking are:

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- Greater effectiveness than classic walking thanks to the use of sticks, which allow for the training of upper body parts.
- Load reduction on articulations (ankles, knees, vertebral column), which makes nordic walking particularly suitable for those people recovering from traumas or suffering from articulations pathologies.
- Improvement of circulation and heart and lungs performances.
- Tension and contracture reduction in cervical and shoulders zones.
- Improvement in total body muscle vigour.
- Stress and emotional tension reduction thanks to physical movement and open air practice.

Nordic walking is designed as a sport to provide benefits for the whole body and mind, while enjoying the discovery of natural environments.

THE TECHNIQUE

The movement is constituted by opposed pushes of arms and legs: left leg and right arm move alternatively to right leg and left arm.

Body posture needs to be upright and relaxed, similarly to that of the vertebral column: of the objectives of nordic walking is bringing this technique to everyday life in order to find the proper walking posture without sticks, constantly using abs and back muscles.

The technique involves leaning slightly forward without flexing your chest, keeping shoulders relaxed and making wide arm movements.

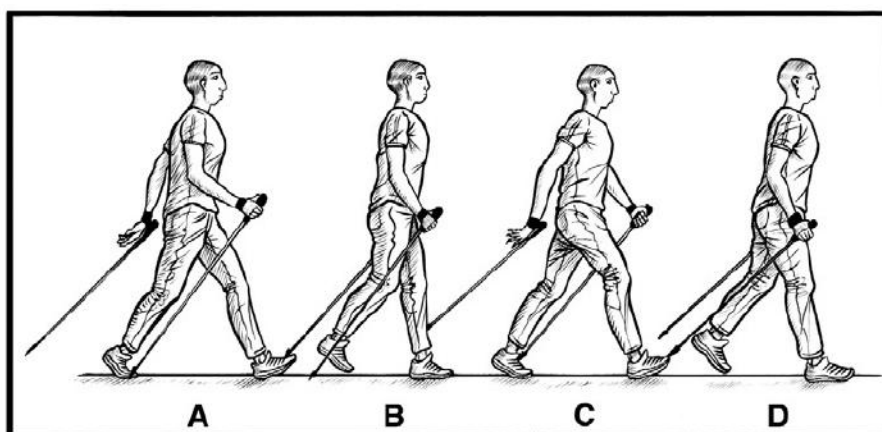
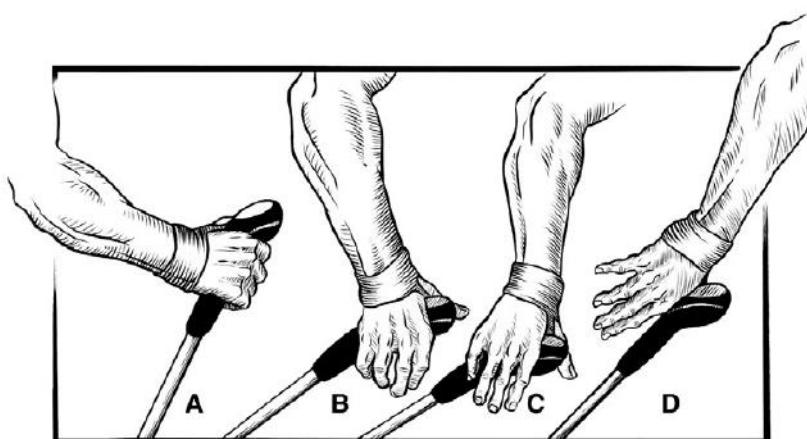
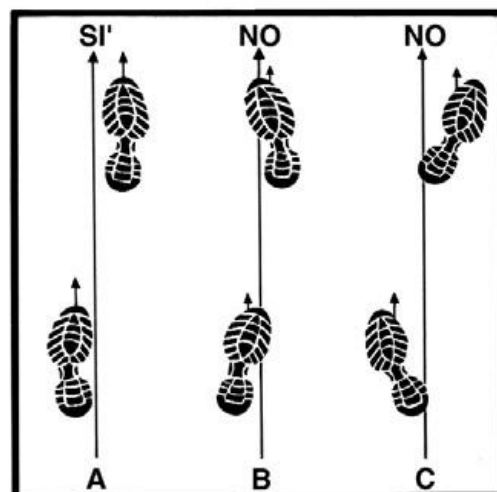
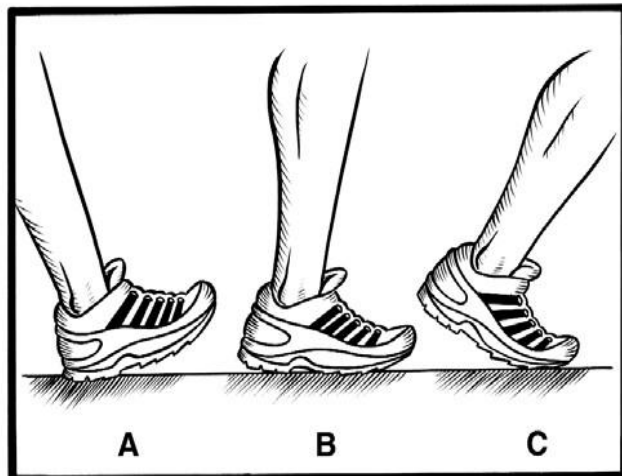
The arms are stretched as they sustain the shoulders' functional rotation, resulting in a significant muscle effort. The hands make straight back and forth movements, and the sticks are always close to the side of the body.

The length of the pace is determined by the possibility of rotating the hip in a balanced way. As a matter of fact, steps are neither long nor short, but appropriate to the extension of the movement, the thrust, and the morphology of the land where the sport is practiced.

The sticks do not change the way of walking. On the contrary, they are a tool helping making walking healthier and more dynamic. The sticks are kept tilted, the none stick is pushed back beyond your hip until you reach a good extension of the arm (sticks are designed to be an extension of the arms).

Here are some illustrations of how to perform the described movement:

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THE WORKSHOP

You need:

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- sticks
- comfortable sneakers
- appropriate sport clothes
- gloves
- backpack with snacks
- map

Characteristics of the route:

- Level of difficulty: low
- Length 5,0 Km
- Environment: parks, beach, trails

STEP1: WARMING UP – 15 MINUTES

Before training, it is always recommendable to warm up.

The following are some warm up drills:

- Thighs: lift alternatively both legs bringing one knee at hip level.
- Calves: lift your heels without pushing on the sticks.
- Abductors: make your foot 'draw' a semi-circle laterally, while your raised foot goes beyond the pivot foot (as illustrated in the photo).
- Lower limbs: from the upright position, squat bending legs and thighs, making sure of not raising your heels from the ground; if need be, it is possible to slightly stretch apart your legs and move the tips of your shoes externally.
- Shoulders' back part: stretch your arms back keeping the sticks in hand.
- Upper body: 'draw' a semi-circle with the tip of the sticks from an upright position.
- Rower drill: simulating a rowing movement with the sticks left and right.

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STEP2: WALKING – 45 minutes (2,5 Km)

Use the walking technique, being careful to:

- Keep straight your stare and not look at your feet in order for your cervical zone to stay upright and support the movement.
- Keep your shoulders relaxed and swing your arms.
- Keep your torso upright and relaxed.
- Lean slightly forward without bending your chest.
- Keep the sticks tilted (not vertically).

STEP2: SNACK BREAK – 30 minutes

Suggested food: fruits (already washed and peeled!!), fruits juices with low sugar levels, and fruits stock.

STEP3: WALKING (way back) – 45 minutes (2,5 Km)

STEP4: STRETCHING– 20 minutes

- Anterior thigh stretching: stretch your feet apart at the level of your hips. Use the sticks to keep balance and hold them both in one hand. Hold with your free hand the instep of one foot trying to bring the heel toward the gluteus.
- Posterior thigh stretching: stretch your feet apart at the level of your hips, then bring one leg forward at a time extending it and raising the tip of the foot, bending forward and keeping your back upright. piegarsi in avanti mantenendo la schiena diritta e cercando di portare i bastoncini verso la punta del piede.
- Calves stretching: divaricare i piedi alla larghezza delle anche, con i bastoncini in appoggio a terra allungare posteriormente l'arto inferiore e piegare il ginocchio dell'altro. Appoggiare il tacco a terra della gamba allungata, avendo l'accortezza di tenere il piede dritto, fino alla soglia di leggero bruciore percepito nel polpaccio
- Back muscles stretching: open wide your feet to the width of the hips, stretch your arms and place the sticks on the ground shoulder width apart by exerting pressure on poles with arms almost stretched. For greater effectiveness bend your head down towards the ground.

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- Side body muscles stretching: stretch your feet apart slightly more than the breath of your hips, grab the sticks and extend them over your head and with your arms extended (as if stretching an elastic band). From this position, pivoting on your belly button and with your back upright, bend your chest both sides without rotating it.

Why don't we make exercise together?

That's how:



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Conclusion

The ageing of population represents one of the most important current social phenomenon. Longer life expectations do not merely means a longer lifespan, but they involve the perspective of living a life in full autonomy.

In order for this to occur, it is necessary for people over 65 to be aware that 2 main factors influence their health:

- Nutrition
- Physical activity

This guideline represent the answer to the people's need to keep healthy following few simple rules in their daily routine:

- The main components of a healthy diet
- The daily energy need
- Recommended and not recommended food
- The subdivision of meals during the day
- The importance of physical activity
- The different types of physical activity
- How to measure physical activity
- Practical workout exercises

We made use of:

- LANGUAGE: direct and non-formal
- IMAGES: clear and explicative
- DATA: easy to interpret and understand
- WORKOUT DRILLS: easily replicable (even at home)

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Remember that... healthy diet and regular physical activity help us to live better, but do not forget to do it all in the way that you like and that makes you happy ... why also happiness is healthy !!



Sociodemographic determinants of diet quality of the EU elderly: a comparative analysis in four countries

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Abstract

Objective: To investigate the sociodemographic determinants of diet quality of the elderly in four EU countries.

Design: Cross-sectional study. For each country, a regression was performed of a multidimensional index of dietary quality *v.* sociodemographic variables.

Setting: In Finland, Finnish Household Budget Survey (1998 and 2006); in Sweden, SNAC-K (2001–2004); in the UK, Expenditure & Food Survey (2006–07); in Italy, Multi-purpose Survey of Daily Life (2009).

Subjects: One- and two-person households of over-50s (Finland, *n* 2994; UK, *n* 4749); over-50s living alone or in two-person households (Italy, *n* 7564); over-60s (Sweden, *n* 2023).

Results: Diet quality among the EU elderly is both low on average and heterogeneous across individuals. The regression models explained a small but significant part of the observed heterogeneity in diet quality. Resource availability was associated with diet quality either negatively (Finland and UK) or in a non-linear or non-statistically significant manner (Italy and Sweden), as was the preference for food parameter. Education, not living alone and female gender were characteristics positively associated with diet quality with consistency across the four countries, unlike socio-professional status, age and seasonality. Regional differences within countries persisted even after controlling for the other sociodemographic variables.

Conclusions: Poor dietary choices among the EU elderly were not caused by insufficient resources and informational measures could be successful in promoting healthy eating for healthy ageing. On the other hand, food habits appeared largely set in the latter part of life, with age and retirement having little influence on the healthiness of dietary choices.

Keywords
Elderly
Ageing
Diet quality
Socio-economic
Sociodemographic
Healthy eating
Nutritional health

It is now well established that the EU population is ageing, which creates important challenges for the functioning of public services and raises fundamental questions about the evolution of human welfare. A few figures help appreciate the magnitude and speed of the changes ahead. Eurostat forecasts that the proportion of the EU population over the age of 65 years (80 years) will increase steadily from 16.0% (4.1%) in 2010 to 27.8% (10.1%) in 2050⁽¹⁾. Meanwhile, the demographic projections of the ANCIEN project of the EU Seventh Framework Programme suggest that life expectancy at age 65 years will increase by about 3 years from 2008 to 2040⁽²⁾. † The problems that this evolution

entails for the funding of pensions, organisation of social care and funding of health services are well known, but there also concerns that longer lives can have grim consequences for the elderly themselves, with prolonged periods of disability, functional limitations, ailments and/or vegetative existence before death. As a result, healthy ageing, defined as the prevention of diseases as well as the delaying of the deterioration of health status, has become a key objective of European public health policy.

Although the question of whether people in the industrial world are living not only longer but also better remains open, ‡ science has now clearly established that

† Even more starkly, the number of centenarians in the UK is projected to increase from 14 500 in 2012 to 110 000 in 2035⁽³⁾.

‡ For instance, in the UK the Office of National Statistics has found that the proportions of life spent disability-free increased for women but mostly fell for men at age 65 years between 2004–06 and 2007–09⁽⁶⁾.

ageing processes are fortunately modifiable⁽⁴⁾. In particular, evidence is accumulating that nutrition interacts with the ageing process in numerous ways and it is therefore believed that healthy eating can be used to slow functional declines and the onset of age-related chronic diseases⁽⁵⁾. However, in addition to robust scientific assessment of the nutrition–ageing relationship, effective nutritional policy for healthy ageing requires a clear understanding of what is driving the elderly to adopt particular diets and what can be done at population or individual level to increase the healthiness of those diets.

Although these questions have been the subject of some research, a literature review indicates some important gaps in knowledge: only a small number of studies have investigated the EU elderly specifically and, while research so far has identified a large number of potential drivers of diet quality and food choices among the elderly, the influence of each factor is rarely quantified and identified *ceteris paribus*. This makes interpretation of the observed associations difficult because of possible confounding and, as a result, the fundamental barriers to the adoption of healthy diets remain unclear. For instance, an unconditional positive association between income and diet quality cannot establish whether poor diets are driven by a lack of resources or limited education, as the latter is strongly correlated with the former. While recognising the merits of unconditional analysis for targeting policies⁽⁷⁾, we believe that the conditional approach that we follow brings more insights for the design of policies to promote healthy eating (e.g. choice of income transfer *v.* informational campaign).

Against this background, the present paper analyses the economic, social and demographic determinants of diet quality among elderly individuals in four EU countries, namely the UK, Italy, Sweden and Finland.

Materials and methods

Index of dietary quality

Although many studies have investigated the determinants of diet quality by focusing on a single dietary component (e.g. saturated fat, fruit and vegetable intake), a more holistic approach considering the entire diet seems preferable in order to guide policy⁽⁸⁾. Multidimensional indices of diet quality have therefore been developed, with a large number of variants reflecting somewhat arbitrary choices regarding the foods and nutrients included and the aggregation procedure (e.g. cut-off values, scoring methods) as described in the detailed reviews of Kant⁽⁹⁾ and Waijers *et al.*⁽¹⁰⁾. The choice of index is difficult as none has been shown to be more strongly associated with health outcomes⁽¹⁰⁾, but four original indices (Healthy Eating Index, Diet Quality Index (DQI), Mediterranean Diet Score, Healthy Eating Indicator) have been validated and used most extensively. Ultimately,

based on these reviews, data availability and the objective of ensuring consistency across the country data sets, the DQI of Patterson *et al.*⁽¹¹⁾ was selected. As our investigation was part of the large EU-funded NU-AGE project on healthy ageing, this choice was also discussed and agreed within the project with experts in nutrition of the elderly. The following important modifications were then made to the original DQI.

1. For each of its components, the original DQI takes only integer values of 0, 1 and 2. This creates arbitrary discontinuities and we therefore preferred to build each component as a continuous piece-wise linear function between the minimum value, set at 0, and the maximum value, set at 10.
2. The original DQI was based on the US nutritional recommendations, which do not suit the European context. It was therefore adjusted in view of the Finnish Nutritional Recommendations.*

Table 1 describes the specific criteria used to define the bounds of the eight components of the DQI, which covers intakes of macronutrients (total fat, saturated fat, protein and carbohydrate), cholesterol, minerals (sodium and calcium) and fruits and vegetables. The score takes a value between 0 and 80.

The Italian data set only provides a dietary record at a high level of product aggregation. This information is not detailed enough to allow calculation of some of the components of the DQI focusing on micronutrients (e.g. calcium). Hence, the alternative Recommendation Compliance Index (RCI) of Mazzocchi *et al.*⁽¹²⁾ was used to measure diet quality on the Italian data, as this index is based on relative dietary composition (e.g. shares of energy intake from various nutrients) and its distance from the recommended WHO diet. While this complicates the comparison of results across countries, a check on the UK data that allows computation of both indices indicated a significant and high degree of correlation between RCI and DQI scores.†

Data

A data mapping exercise covering the four countries as well as the EU was carried out in order to identify secondary data sets suitable for the analysis. The key selection criteria included the number of observations specifically on older individuals, year of collection, comprehensiveness of the food and nutrient intake data, and extensiveness of the socio-economic information collected. On that basis, we selected the four data sets described succinctly in Table 2. With one exception in the

* We did not adjust the definition of the DQI to reflect the recommendations in each of the four countries because this would have made comparison of the country-level results difficult. Given that our focus is on heterogeneity of diets, the choice of the benchmark recommendations has a negligible impact on the results.

† The correlation coefficient was 0.70.

Table 1 Diet quality indices

| Diet Quality Index (DQI) | | | |
|--------------------------|----------------|-------------------------------|------------------------------|
| Component | Range of score | Criterion for max score of 10 | Criterion for min score of 0 |
| 1. Total fat | 0–10 | <30 E% | >40 E% |
| 2. Saturated fat | 0–10 | <10 E% | >13.3 E% |
| 3. Cholesterol | 0–10 | <300 mg/d | >400 mg/d |
| 4. Sodium | 0–10 | <2000 mg/d | >2800 mg/d |
| 5. Calcium | 0–10 | ≥800 mg/d | <533 mg/d |
| 6. Fruits and vegetables | 0–10 | 5 servings/d | ≤2 servings/d |
| 7. Protein | 0–10 | ≤100% DRI | >150% DRI |
| 8. Total carbohydrates | 0–10 | ≥55 E% | <37 E% |

Recommendation Compliance Index (RCI, Italy)

| Component | Criterion to meet recommendation (score = 1) |
|--------------------------|----------------------------------------------|
| 1. Fats | 15–30 E% |
| 2. Saturated fat | <10 E% |
| 3. <i>Trans</i> -fats | <1 E% |
| 4. Carbohydrate | 55–75 E% |
| 5. Protein | 10–15 E% |
| 6. Fruits and vegetables | 5 servings/d (or 400 g/d) |
| 7. Raw sugar | ≤10 E% |

E%, percentage of energy; DRI, Dietary Reference Intake.

case of Sweden, the data were not derived from surveys targeting the elderly specifically and it was therefore necessary to define a minimum age of eligible individuals. Although the traditional definition of the elderly sets an age limit of 65 years, we decided to lower that limit to 50 years to provide a basis for comparison of elderly and non-elderly households/individuals. Another reason for this age limit was that we also wanted to understand the potential impact of retirement on food choices and diet quality, which requires data on both retired and active individuals.* A broader age bracket also allowed us to better appreciate the impact of ageing on diet quality, while giving us larger samples.† For Finland and the UK, the data recorded information at the level of the household rather than the individual and, in those cases, only one- and two-person households formed of individuals over the age limit were selected.‡ In order to improve consistency, individual data taken from the Italian data set only included those aged above 50 years who lived alone or in two-person households. Finally, in order to limit the influence of outliers on the results, observations with

* We recognise that the term ‘elderly’ does not describe very well the demographic group over the age of 50 years, but we keep it for convenience and conciseness.

† A more minor reason relates to the fact that the socio-professional status of individuals over the age of 65 years is often not described in detail, as they are usually lumped together into a ‘pensioner’ category.

‡ Hence, in the case of the UK, Italy and Finland, we ignored the elderly individuals living with non-elderly individuals. For Finland, the available data allowed us to calculate that a large majority of those aged 65 years and over in the sample belonged to the types of households selected in the analysis.

extreme values for the eight nutrient (or food) intakes entering the DQI were excluded by removing the 1% tail of the distribution on each side.

Multivariate regression analysis

Given the high level of correlation among socio-demographic variables (e.g. education and income), multivariate regression models were used to quantify the association of each variable to diet quality *ceteris paribus*. Further, a common model was defined for the four samples in order to maximise comparability of results and ease of interpretation. The exact selection of explanatory variables was guided by existing literature as well as availability of particular data in the four samples, resulting in the model defined in the left column of Table 3. Some important remarks are in order.

1. Although resource availability is often mentioned as a key driver of the food choices of the elderly, constructing a related variable for empirical analysis raises several difficulties. Income is not particularly appropriate to measure the resources available for consumption because pensioners often fund their expenses from savings. Meanwhile, the food budget is itself endogenous in the sense that it results from a choice, so that regression models including that variable may be spurious. Ultimately, resource availability was measured by total consumption expenditure where possible (UK and Finnish samples) with two adjustments. First, in multi-individual households, economies of scale in consumption were accounted for by dividing total household expenditure by the number of consumption units (rather than individuals) as defined by the Organisation for Economic Co-operation and Development.§ Second, the expenditure variable entered the model in logarithmic terms to accommodate the broad range of the data.
2. The Italian and Swedish data sets measure financial resources only through answers to qualitative questions, which were included through appropriate dummy variables.||
3. In the two data sets that measure expenses quantitatively, it was possible to build a preference for food variable defined as the share of total expenditure allocated to food.
4. The educational levels, referred to as primary, secondary and tertiary in the text, were defined in each country and introduced into the model through two dummy variables (the reference category in

§ In practice, this means dividing total expenditure of two-person households by 1.5.

|| In the Swedish data set, the resource constraint is measured by a yes/no answer to the question ‘Do you face difficulties in taking care of your daily expenses?’; in the case of Italy, the respondents were simply asked to characterize their financial resources as being insufficient, poor, adequate or very good.

Table 2 Characteristics of the four data sets

| Country | General characteristics | | | | Observations included | | Food data | | |
|---------|----------------------------------------------------|-----------------------------|---------------------------------|---------------|---------------------------------------------------------------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|-------------------------------------------------------------------------------------------------|
| | Name | Level and type | Representativeness | Year(s) | Criteria | <i>n</i> | Type | Collection | Composition database |
| UK | Expenditure and Food Survey (EFS) | Household, cross-sectional | Nationally for whole population | 2006 and 2007 | One- and two-person households, age ≥ 50 years | 4749 | Quantity and expenditure information on food and drinks purchases, more than 500 food codes | Two-week diary (including food eaten out) | Department for Environment, Food and Rural Affairs |
| Finland | Household Budget Survey | Household, cross-sectional | Nationally for whole population | 1998 and 2006 | One- and two-person households, age ≥ 50 years | 2994 | Consumption, 254 COCIP codes | Two-week diary plus receipts | Fineli |
| Italy | Multi-purpose Survey on Daily Life | Individual, cross-sectional | Nationally for whole population | 2009 | Individuals aged ≥ 50 years living in one- and two-person households | 7564 | Food frequency, 16 aggregate food categories (bakery products, processed meats, poultry, beef, pork, milk, dairy products, eggs, fish, leaf vegetables, other vegetables, fruit, pulses, potatoes, salted snacks, confectionery) | Questionnaire, face-to-face interviews | Italian National Institute for Research on Food and Nutrition |
| Sweden | Swedish National Survey on Aging and Care (SNAC-K) | Individual, cross-sectional | Community-based population | 2001–2004 | Age ≥ 60 years, living either at home or institutions | 2023 | Semi-quantitative FFQ | Self-administered at first visit | National Food Composition database, using the software MATS (Rudans Lättdata, Västerås, Sweden) |

Table 3 Determinants of diet quality in the UK

| | Macronutrients | | | | | | | | | | Other | | | | | | | | | |
|------------------------------|----------------------|--------|----------------|-------|--------------------|-------|-----------------|--------|-----------|-------|---------------------|--------|----------------|--------|-----------------|--------|-------------|--------|-------------|---------|
| | Total energy, log(.) | | Total fat (E%) | | Saturated fat (E%) | | Protein, log(.) | | CHO (E%) | | Cholesterol, log(.) | | Sodium, log(.) | | Calcium, log(.) | | F&V, log(.) | | DQI | |
| | β | SE | β | SE | β | SE | β | SE | β | SE | β | SE | β | SE | β | SE | β | SE | β | SE |
| Constant | 139.110*** | 31.321 | -8.828* | 4.518 | 7.649*** | 2.199 | 152.800*** | 31.213 | 9.852* | 5.296 | 196.872*** | 36.844 | 76.114** | 33.685 | 135.077*** | 32.582 | 544.821*** | 51.064 | 2575.929*** | 863.450 |
| Log (total expenditure/CU) | 0.215*** | 0.019 | 0.006** | 0.002 | 0.003** | 0.001 | 0.231*** | 0.019 | -0.008*** | 0.003 | 0.234*** | 0.022 | 0.218*** | 0.020 | 0.185*** | 0.020 | 0.324*** | 0.030 | -3.835*** | 0.485 |
| Food share of expenditure | 3.130*** | 0.197 | 0.118*** | 0.027 | 0.047*** | 0.013 | 3.265*** | 0.197 | -0.022 | 0.033 | 3.326*** | 0.229 | 3.139*** | 0.207 | 2.713*** | 0.203 | 3.498*** | 0.332 | -56.772*** | 5.113 |
| Household type (ref. Couple) | | | | | | | | | | | | | | | | | | | | |
| Male alone | 0.094*** | 0.023 | -0.002 | 0.003 | -0.001 | 0.002 | 0.095*** | 0.023 | -0.005 | 0.004 | 0.098*** | 0.027 | 0.119*** | 0.025 | 0.069*** | 0.024 | 0.033 | 0.038 | -1.772*** | 0.649 |
| Female alone | 0.050*** | 0.019 | -0.000 | 0.003 | 0.001 | 0.001 | 0.050*** | 0.019 | 0.006* | 0.003 | 0.033 | 0.022 | 0.051** | 0.020 | 0.044** | 0.019 | 0.035 | 0.031 | -1.443*** | 0.507 |
| Education (ref. Primary) | | | | | | | | | | | | | | | | | | | | |
| Tertiary | -0.015 | 0.019 | -0.003 | 0.003 | -0.002 | 0.001 | -0.012 | 0.019 | 0.003 | 0.003 | -0.019 | 0.023 | -0.023 | 0.021 | -0.023 | 0.020 | 0.113*** | 0.030 | 0.902* | 0.533 |
| Employment (ref. Pensioner) | | | | | | | | | | | | | | | | | | | | |
| Self-employed | -0.015 | 0.036 | -0.001 | 0.005 | 0.003 | 0.003 | 0.008 | 0.037 | -0.001 | 0.006 | 0.016 | 0.043 | 0.008 | 0.039 | -0.007 | 0.038 | -0.012 | 0.062 | 0.252 | 1.081 |
| Manager | -0.057 | 0.046 | -0.016** | 0.006 | -0.004 | 0.003 | -0.048 | 0.045 | 0.010 | 0.008 | -0.057 | 0.054 | -0.047 | 0.051 | -0.067 | 0.044 | 0.047 | 0.066 | 2.641** | 1.306 |
| Employee | 0.005 | 0.024 | -0.000 | 0.003 | 0.001 | 0.002 | 0.018 | 0.024 | -0.003 | 0.004 | 0.019 | 0.028 | 0.038 | 0.026 | -0.018 | 0.025 | -0.068* | 0.041 | -0.890 | 0.650 |
| Age (ref. 50-54 years) | | | | | | | | | | | | | | | | | | | | |
| 55-60 years | -0.017 | 0.030 | 0.005 | 0.004 | 0.001 | 0.002 | -0.010 | 0.030 | -0.005 | 0.005 | -0.000 | 0.035 | -0.011 | 0.032 | -0.022 | 0.031 | 0.043 | 0.049 | -1.151 | 0.832 |
| 60-65 years | 0.014 | 0.029 | 0.001 | 0.004 | 0.001 | 0.002 | 0.009 | 0.029 | -0.003 | 0.005 | 0.049 | 0.034 | 0.014 | 0.031 | -0.015 | 0.030 | 0.032 | 0.049 | -1.246 | 0.793 |
| 65-70 years | -0.060* | 0.031 | -0.001 | 0.004 | 0.002 | 0.002 | -0.043 | 0.030 | -0.000 | 0.005 | -0.015 | 0.036 | -0.050 | 0.033 | -0.075** | 0.032 | 0.040 | 0.052 | 0.033 | 0.880 |
| 70-75 years | -0.019 | 0.032 | 0.002 | 0.005 | 0.004* | 0.002 | -0.024 | 0.032 | 0.002 | 0.005 | 0.001 | 0.038 | -0.028 | 0.034 | -0.028 | 0.033 | 0.062 | 0.054 | -0.227 | 0.905 |
| 75-80 years | -0.043 | 0.034 | -0.002 | 0.005 | 0.003 | 0.002 | -0.043 | 0.034 | 0.003 | 0.006 | 0.003 | 0.039 | -0.020 | 0.036 | -0.046 | 0.034 | 0.082 | 0.056 | 0.355 | 0.949 |
| >80 years | -0.120*** | 0.035 | 0.001 | 0.005 | 0.007*** | 0.002 | -0.120*** | 0.035 | 0.000 | 0.006 | -0.063 | 0.040 | -0.131*** | 0.038 | -0.135*** | 0.036 | 0.013 | 0.060 | 1.317 | 0.946 |
| Year (ref. 2007) | | | | | | | | | | | | | | | | | | | | |
| 2006 | -0.012 | 0.022 | -0.000 | 0.003 | -0.000 | 0.002 | -0.012 | 0.022 | 0.001 | 0.004 | -0.010 | 0.026 | 0.018 | 0.024 | 0.022 | 0.023 | 0.007 | 0.037 | 0.052 | 0.604 |
| Quarter (ref. Quarter 4) | | | | | | | | | | | | | | | | | | | | |
| Quarter 1 | -0.044** | 0.022 | 0.006* | 0.003 | 0.003 | 0.002 | -0.022 | 0.022 | -0.005 | 0.004 | -0.036 | 0.026 | -0.001 | 0.023 | -0.002 | 0.023 | 0.033 | 0.036 | -0.281 | 0.607 |
| Quarter 2 | -0.033 | 0.022 | 0.002 | 0.003 | 0.002 | 0.002 | -0.012 | 0.022 | -0.002 | 0.004 | -0.020 | 0.026 | -0.002 | 0.024 | 0.003 | 0.022 | 0.054 | 0.035 | -0.301 | 0.601 |
| Quarter 3 | -0.067*** | 0.016 | 0.005** | 0.002 | -0.004*** | 0.001 | -0.075*** | 0.016 | -0.005* | 0.003 | -0.097*** | 0.018 | -0.039** | 0.017 | -0.065*** | 0.016 | -0.273*** | 0.025 | -1.244*** | 0.431 |
| F^2 | 8.4% | | 1.3% | | 1.9% | | 9.3% | | 1.2% | | 7.1% | | 7.6% | | 6.3% | | 8.3% | | 4.0% | |

E%, percentage of energy; CHO, carbohydrate; F&V, fruits and vegetables; DQI, Diet Quality Index; CU, consumption unit; ref., reference category.

***Statistically significant at 1% level; **statistically significant at 5% level; *statistically significant at 10% level; coefficients of regional dummy variables not reported.

Table 3 corresponding to those having achieved at most a primary level of education).

5. The definition of socio-professional categories varies across countries but the reference group used to build the dummy variables corresponds to pensioners. The Swedish data set differs from the others in that it only covers individuals over the age of 60 years who are almost all pensioners and, in that case, socio-professional category refers to the pre-retirement status.
6. Household structure is described by a dummy variable distinguishing those living alone from others (the reference category in Table 3 being couples).
7. The gender dummy in Table 3 takes males as the reference group.
8. To allow for potentially non-linear relationships, age enters the model through dummies for 5-year age brackets, the reference corresponding to the youngest age group.
9. Regional and quarterly dummies are also introduced. For the latter, the fourth quarter is taken as reference for comparison.
10. In the two data sets with repeated cross-sections, a year dummy is also introduced.

Results

On the basis of the calculated index, diet quality of the elderly in the four countries is both relatively poor and heterogeneous. From a maximum achievable score of 80, the mean score in the sample is 50 in Sweden, 36 in Finland and 60 in the UK, with few individuals achieving the maximum score. The distributions of the index in the four samples are in each case wide, indicating that diet quality varies greatly within each population. However, a closer look at the sub-components of the DQI reveals that the nutritional problems underlying the relatively low DQI scores are not necessarily the same across countries. In Finland, excess consumption of salt and saturated fat appears particularly problematic, while underconsumption of fruits and vegetables represents a larger problem in Sweden.

Next, the regression analysis seeks to explain variation in diet quality within each sample by sociodemographic variables. The full regression results are presented in Tables 3–6 separately for each country. In all four countries, several sociodemographic variables explain diet quality of the elderly in a statistically significant manner, but the overall explanatory power of the models remains modest: the R^2 statistic varies from 4% for the UK and Italy to 10% for Sweden and Finland. The low explanatory power of the models, which is not unusual given the cross-sectional nature of the data, could be caused by measurement errors, the omission of important variables or inherent and unobserved heterogeneity (for instance related to tastes). However, we also note that, for all four

countries, total energy consumption is much better explained than diet quality. One potential reason is that diet quality affects well-being (i.e. what economists call ‘utility’) only indirectly, while the choice of energy intake, which determines satiation of hunger, has a more direct impact on utility. Previous authors have used a similar argument to explain why models of demand for macronutrients usually perform much better than corresponding models for micronutrients^(13,14).

However, we also note similarities across the four countries in the way that each sociodemographic variable associates with diet quality. In the UK and Finland, the coefficient of the variable ‘resource availability’ is significant at the 1% level but the direction of the effect is unexpected: relatively better-off households adopt, *ceteris paribus*, diets of relatively poorer quality. The result is explained mainly by a greater share of energy derived from fat and saturated fat and the larger consumption of cholesterol and sodium as total expenditure increases. Those changes influence diet quality negatively and dominate the positive effect of an increase in the consumption of fruits, vegetables and calcium as expenditure rises. For the other two countries, the resource constraint is not found to be significant (Sweden) or monotonically associated with diet quality (Italy) but we note that in both cases, the variable is self-assessed and measured imperfectly.

The variable ‘preference for food’ defined in the previous section is also very significantly and negatively associated with diet quality in the two samples that allow its measurement (corresponding to the UK and Finland). Hence, elderly households that allocate relatively more of their resources to food consumption, holding total expenditure constant, achieve a relatively lower DQI. The explanation lies mainly with a larger share of energy derived from fat and an increase in the consumption of cholesterol as the share of expenditure allocated to food expands. The qualitative variables used to measure resource availability in Italy and Sweden do not permit the construction of a comparable variable measuring the elderly’s preference for food.

Next, the association between education and diet quality is investigated. Taking individuals having at most completed primary school as a reference, it is found in all four countries that achieving a tertiary level of education is associated with higher diet quality. In the case of Italy, the result extends to secondary education. Hence, there is evidence that the better-educated elderly make healthier food choices and that the effect is not due to the correlates of education, such as higher income, which are controlled for. Although the exact underlying mechanisms seem different in the four samples, the relatively higher consumption of fruits and vegetables of the more-educated elderly emerges in all four countries and, in the two Nordic countries, the analysis also reveals that education is associated with lower consumption of saturated fat.

Table 4 Determinants of diet quality in Italy

| | Macronutrients | | | | | | | | | | Other | | | | | |
|-----------------------------------------|----------------------|-------|----------------|-------|--------------------|-------|-----------------|-------|-----------|-------|---------------------|-------|--------------|-------|----------|-------|
| | Total energy, log(.) | | Total fat (E%) | | Saturated fat (E%) | | Protein, log(.) | | CHO (E%) | | Cholesterol, log(.) | | F&V portions | | RCI | |
| | β | SE | β | SE | β | SE | β | SE | β | SE | β | SE | β | SE | β | SE |
| Constant | 3.158*** | 0.009 | 20.819*** | 0.366 | 9.996*** | 0.211 | 2.452** | 0.010 | 59.296*** | 0.511 | 2.305*** | 0.025 | 2.299*** | 0.105 | 0.715* | 0.008 |
| Financial resources (ref. Insufficient) | | | | | | | | | | | | | | | | |
| Poor | 0.026*** | 0.007 | 0.557** | 0.257 | 0.281* | 0.148 | 0.029*** | 0.007 | -0.654* | 0.359 | 0.055*** | 0.018 | 0.093 | 0.074 | 0.011* | 0.006 |
| Adequate | 0.032*** | 0.007 | 0.824*** | 0.257 | 0.441*** | 0.148 | 0.036** | 0.007 | -0.940*** | 0.358 | 0.070*** | 0.018 | 0.262*** | 0.074 | 0.024** | 0.006 |
| Very good | 0.031* | 0.016 | 1.239** | 0.615 | 0.552 | 0.354 | 0.047*** | 0.016 | 1.921** | 0.857 | 0.099** | 0.042 | 0.129 | 0.176 | 0.015 | 0.014 |
| Household type (ref. Couple) | | | | | | | | | | | | | | | | |
| Male alone | 0.017*** | 0.004 | -0.241 | 0.165 | -0.194** | 0.095 | 0.020*** | 0.004 | 0.051 | 0.230 | 0.020* | 0.011 | -0.366** | 0.047 | -0.025* | 0.004 |
| Female alone | -0.060*** | 0.004 | 0.338** | 0.137 | 0.250*** | 0.079 | -0.068** | 0.004 | 0.071 | 0.191 | -0.069*** | 0.009 | -0.030 | 0.039 | -0.009* | 0.003 |
| Education (ref. Primary) | | | | | | | | | | | | | | | | |
| Secondary | 0.011*** | 0.003 | 0.339*** | 0.124 | 0.140* | 0.071 | 10.013*** | 0.003 | -0.419** | 0.172 | 0.018** | 0.009 | 0.198*** | 0.035 | 0.015** | 0.003 |
| Tertiary | -0.008 | 0.006 | 0.650*** | 0.240 | 0.289** | 0.138 | -0.004 | 0.006 | -0.845** | 0.335 | -0.030* | 0.017 | 0.462*** | 0.069 | 0.029** | 0.006 |
| Employment (ref. Retired) | | | | | | | | | | | | | | | | |
| Self-employed | 0.006 | 0.006 | 0.662*** | 0.214 | 0.298** | 0.123 | 0.011* | 0.006 | -0.890*** | 0.299 | 0.018 | 0.015 | -0.002 | 0.061 | -0.000 | 0.005 |
| Manager | -0.009 | 0.011 | 0.784* | 0.427 | 0.432* | 0.246 | -0.005 | 0.011 | -0.928 | 0.596 | 0.012 | 0.030 | -0.371** | 0.122 | -0.029* | 0.010 |
| Employee | -0.017*** | 0.005 | 0.665*** | 0.175 | 0.344*** | 0.100 | -0.016** | 0.005 | -0.672*** | 0.243 | -0.023* | 0.012 | -0.123** | 0.050 | -0.013* | 0.004 |
| Age (ref. 50–54 years) | | | | | | | | | | | | | | | | |
| 55–60 years | -0.018*** | 0.006 | -0.392 | 0.250 | -0.089 | 0.144 | -0.011 | 0.007 | 0.019 | 0.349 | -0.023 | 0.017 | 0.129* | 0.072 | 0.008 | 0.006 |
| 60–65 years | -0.012* | 0.007 | -0.600** | 0.256 | -0.124 | 0.147 | -0.003 | 0.007 | 0.151 | 0.357 | -0.021 | 0.018 | 0.146** | 0.073 | 0.010 | 0.006 |
| 65–70 years | -0.015** | 0.007 | -0.666** | 0.263 | 0.069 | 0.151 | 0.003 | 0.007 | -0.187 | 0.367 | -0.016 | 0.018 | 0.122 | 0.075 | 0.008 | 0.006 |
| 70–75 years | -0.012* | 0.007 | -0.981*** | 0.271 | -0.216 | 0.156 | 0.002 | 0.007 | 0.360 | 0.379 | -0.009 | 0.019 | 0.088 | 0.078 | 0.007 | 0.006 |
| 75–80 years | -0.014* | 0.007 | -0.581** | 0.279 | 0.058 | 0.161 | 0.000 | 0.007 | -0.097 | 0.389 | -0.014 | 0.019 | 0.011 | 0.080 | -0.000 | 0.006 |
| >80 years | -0.017** | 0.007 | -0.754*** | 0.278 | 0.062 | 0.160 | -0.002 | 0.007 | 0.002 | 0.388 | -0.033* | 0.019 | -0.092 | 0.080 | -0.010 | 0.006 |
| Region (ref. North-West) | | | | | | | | | | | | | | | | |
| North-East | 0.004 | 0.004 | -0.043 | 0.154 | 0.031 | 0.088 | 0.003 | 0.004 | 0.080 | 0.214 | 0.002 | 0.011 | 0.103** | 0.044 | 0.009** | 0.004 |
| Central | 0.002 | 0.004 | -1.498*** | 0.164 | -0.886*** | 0.095 | 0.001 | 0.004 | 1.490*** | 0.229 | -0.009 | 0.011 | 0.062 | 0.047 | 0.011** | 0.004 |
| South | -0.015*** | 0.004 | -1.826*** | 0.155 | -1.034*** | 0.089 | -0.018** | 0.004 | 1.975*** | 0.216 | -0.025** | 0.011 | -0.311** | 0.044 | -0.020** | 0.004 |
| Islands | -0.007 | 0.006 | -1.748*** | 0.213 | -0.878*** | 0.123 | -0.008 | 0.006 | 1.813*** | 0.297 | -0.013 | 0.015 | -0.153** | 0.061 | -0.008* | 0.005 |
| R^2 | 6.3% | | 5.0% | | 4.2% | | 7.7% | | 2.5% | | 1.6% | | 4.5% | | 3.9% | |

E%, percentage of energy; CHO, carbohydrate; F&V, fruits and vegetables; RCI, Recommendation Compliance Index; ref., reference category.

***Statistically significant at 1% level; **statistically significant at 5% level; *statistically significant at 10% level.

Table 5 Determinants of diet quality in Finland

| | Macronutrients | | | | | | | | | | Other | | | | | | | | | |
|-------------------------------|----------------------|-------|----------------|-------|--------------------|-------|-----------------|-------|-----------|-------|---------------------|-------|----------------|-------|-----------------|-------|-------------|-------|------------|-------|
| | Total energy, log(.) | | Total fat (E%) | | Saturated fat (E%) | | Protein, log(.) | | CHO (E%) | | Cholesterol, log(.) | | Sodium, log(.) | | Calcium, log(.) | | F&V, log(.) | | DQI | |
| | β | SE | β | SE | β | SE | β | SE | β | SE | β | SE | β | SE | β | SE | β | SE | β | SE |
| Constant | -0.380 | 0.318 | 0.238*** | 0.041 | 0.098*** | 0.021 | -3.860*** | 0.330 | 0.578*** | 0.043 | -2.750*** | 0.372 | -0.980* | 0.560 | -0.070 | 0.348 | -3.390*** | 0.359 | 123.200*** | 6.875 |
| Log (total expenditure/CU) | 0.749*** | 0.031 | 0.011*** | 0.004 | 0.004** | 0.002 | 0.770*** | 0.032 | -0.010*** | 0.004 | 0.787*** | 0.036 | 0.821*** | 0.054 | 0.648*** | 0.034 | 0.867*** | 0.035 | -8.020*** | 0.673 |
| Food share of expenditure | 4.996*** | 0.171 | 0.058*** | 0.022 | 0.008 | 0.011 | 5.039*** | 0.179 | -0.020 | 0.023 | 5.282*** | 0.202 | 4.880*** | 0.299 | 4.280*** | 0.187 | 4.526*** | 0.191 | -52.900*** | 3.634 |
| Household type (ref. Couple) | | | | | | | | | | | | | | | | | | | | |
| Male alone | 0.121*** | 0.037 | -0.000 | 0.004 | -0.000* | 0.002 | 0.129*** | 0.038 | 0.004 | 0.005 | 0.117*** | 0.043 | 0.058 | 0.066 | 0.026 | 0.040 | -0.110*** | 0.042 | -2.040** | 0.832 |
| Female alone | 0.119*** | 0.028 | -0.000 | 0.003 | -0.000 | 0.001 | 0.087*** | 0.029 | 0.006 | 0.003 | 0.139*** | 0.032 | -0.000 | 0.050 | 0.118*** | 0.030 | 0.195*** | 0.031 | -1.390** | 0.622 |
| Education (ref. Primary) | | | | | | | | | | | | | | | | | | | | |
| Secondary | 0.033 | 0.028 | -0.000 | 0.003 | -0.000* | 0.001 | 0.059** | 0.029 | 0.003 | 0.003 | 0.011 | 0.033 | 0.046 | 0.050 | 0.055* | 0.031 | 0.076** | 0.032 | 0.785 | 0.636 |
| Tertiary | -0.030 | 0.031 | -0.000 | 0.004 | -0.000*** | 0.002 | -0.030 | 0.032 | -0.000 | 0.004 | -0.060* | 0.036 | -0.030 | 0.056 | -0.010 | 0.034 | 0.090** | 0.035 | 1.785** | 0.700 |
| Social group (ref. Pensioner) | | | | | | | | | | | | | | | | | | | | |
| Entrepreneur | 0.047 | 0.051 | -0.000 | 0.006 | 0.001 | 0.003 | 0.039 | 0.052 | 0.007 | 0.007 | 0.056 | 0.059 | 0.051 | 0.090 | 0.050 | 0.056 | 0.028 | 0.057 | 0.773 | 1.131 |
| White collar | -0.050 | 0.041 | -0.000 | 0.005 | 0.002 | 0.002 | -0.060 | 0.042 | 0.003 | 0.005 | -0.150*** | 0.048 | -0.070 | 0.073 | -0.080* | 0.045 | -0.050 | 0.046 | 1.164 | 0.918 |
| Blue collar | 0.052 | 0.046 | 0.007 | 0.006 | 0.002 | 0.003 | 0.006 | 0.048 | -0.000 | 0.006 | -0.000 | 0.054 | 0.047 | 0.082 | 0.003 | 0.050 | -0.040 | 0.052 | -1.110 | 1.034 |
| Other | 0.165*** | 0.062 | -0.000 | 0.008 | -0.000 | 0.004 | 0.147** | 0.064 | 0.001 | 0.008 | 0.123* | 0.072 | 0.327*** | 0.111 | 0.145** | 0.067 | 0.072 | 0.070 | -0.380 | 1.390 |
| Age (ref. 50–54 years) | | | | | | | | | | | | | | | | | | | | |
| 55–60 years | 0.047 | 0.040 | 0.002 | 0.005 | -0.000 | 0.002 | 0.018 | 0.042 | -0.000 | 0.005 | -0.040 | 0.047 | 0.054 | 0.072 | 0.026 | 0.044 | 0.057 | 0.046 | 0.500 | 0.912 |
| 60–65 years | 0.106** | 0.043 | 0.001 | 0.005 | -0.000 | 0.002 | 0.067 | 0.045 | 0.003 | 0.005 | -0.020 | 0.050 | 0.097 | 0.077 | 0.037 | 0.047 | 0.148*** | 0.049 | 1.064 | 0.968 |
| 65–70 years | 0.149*** | 0.050 | -0.000 | 0.006 | -0.000 | 0.003 | 0.094* | 0.052 | 0.007 | 0.006 | 0.065 | 0.059 | 0.161* | 0.090 | 0.106* | 0.055 | 0.185*** | 0.057 | 1.499 | 1.129 |
| 70–75 years | 0.184*** | 0.053 | -0.000 | 0.006 | 0.000 | 0.003 | 0.128** | 0.055 | 0.008 | 0.007 | 0.016 | 0.062 | 0.195** | 0.094 | 0.145** | 0.058 | 0.093 | 0.060 | 1.711 | 1.191 |
| 75–80 years | 0.110* | 0.057 | -0.010* | 0.007 | -0.000 | 0.003 | 0.017 | 0.058 | 0.022*** | 0.007 | -0.060 | 0.066 | 0.057 | 0.101 | 0.024 | 0.062 | 0.020 | 0.064 | 3.251** | 1.271 |
| >80 years | 0.143** | 0.058 | 0.000 | 0.007 | 0.004 | 0.003 | 0.011 | 0.060 | 0.014* | 0.008 | -0.050 | 0.068 | 0.080 | 0.104 | 0.014 | 0.064 | -0.130** | 0.066 | 1.827 | 1.307 |
| Year (ref. 2007) | | | | | | | | | | | | | | | | | | | | |
| 2006 | -0.150*** | 0.023 | 0.006** | 0.003 | 0.006*** | 0.001 | -0.120*** | 0.024 | -0.01*** | 0.003 | -0.180*** | 0.027 | -0.060 | 0.041 | -0.050** | 0.025 | -0.120*** | 0.026 | 0.422 | 0.518 |
| Quarter (ref. Quarter 4) | | | | | | | | | | | | | | | | | | | | |
| Quarter 1 | 0.068** | 0.031 | -0.000* | 0.004 | -0.000** | 0.002 | 0.074** | 0.032 | 0.007* | 0.004 | 0.015 | 0.035 | 0.086 | 0.055 | 0.074** | 0.033 | 0.096*** | 0.034 | 1.401** | 0.686 |
| Quarter 2 | 0.037 | 0.029 | -0.000* | 0.003 | -0.000*** | 0.001 | 0.009 | 0.030 | 0.011*** | 0.004 | -0.050* | 0.034 | 0.112** | 0.052 | 0.000 | 0.032 | 0.020 | 0.033 | 1.262* | 0.659 |
| Quarter 3 | 0.095*** | 0.030 | -0.010*** | 0.003 | -0.000** | 0.002 | 0.041 | 0.031 | 0.013*** | 0.004 | -0.010 | 0.035 | 0.162*** | 0.054 | 0.062* | 0.033 | 0.050 | 0.034 | 1.740** | 0.678 |
| Region (ref. South) | | | | | | | | | | | | | | | | | | | | |
| West | -0.010 | 0.027 | -0.000 | 0.003 | 0.001 | 0.001 | -0.040 | 0.028 | 0.004 | 0.003 | -0.010 | 0.031 | -0.120** | 0.048 | -0.010 | 0.029 | 0.023 | 0.030 | 0.065 | 0.608 |
| East | -0.000 | 0.032 | -0.010*** | 0.004 | -0.000 | 0.002 | -0.000 | 0.033 | 0.006 | 0.004 | 0.030 | 0.037 | -0.080 | 0.057 | 0.002 | 0.035 | 0.099*** | 0.036 | 1.225* | 0.720 |
| North | -0.010 | 0.037 | -0.010*** | 0.004 | -0.000 | 0.002 | 0.019 | 0.038 | 0.005 | 0.005 | -0.010 | 0.043 | -0.060 | 0.066 | 0.062 | 0.041 | -0.000 | 0.042 | 1.916** | 0.832 |
| Åland | -0.100 | 0.066 | -0.000 | 0.008 | 0.002 | 0.004 | -0.090 | 0.069 | -0.000 | 0.009 | 0.034 | 0.077 | -0.190 | 0.118 | -0.100 | 0.072 | 0.063 | 0.075 | 1.400 | 1.480 |
| R ² | 27.0% | | 2.4% | | 2.1% | | 26.2% | | 3.1% | | 23.4% | | 12.6% | | 19.2% | | 27.8% | | 9.5% | |

E%, percentage of energy; CHO, carbohydrate; F&V, fruits and vegetables; DQI, Diet Quality Index; CU, consumption unit; ref., reference category.

***Statistically significant at 1% level; **statistically significant at 5% level; *statistically significant at 10% level.

Table 6 Determinants of diet quality in Sweden

| | Macronutrients | | | | | | | | | | Other | | | | | | | | | |
|--------------------------------------------------|-----------------------|-------|----------------|-------|--------------------|-------|------------------|-------|-----------|-------|----------------------|-------|-----------------|-------|------------------|-------|--------------|-------|-----------|-------|
| | Total energy, log (.) | | Total fat (E%) | | Saturated fat (E%) | | Protein, log (.) | | CHO (E%) | | Cholesterol, log (.) | | Sodium, log (.) | | Calcium, log (.) | | F&V, log (.) | | DQI | |
| | β | SE | β | SE | β | SE | β | SE | β | SE | β | SE | β | SE | β | SE | β | SE | β | SE |
| Constant | 7.485*** | 0.072 | 34.406*** | 1.477 | 13.457*** | 0.772 | 4.080*** | 0.083 | 40.806*** | 1.627 | 5.351*** | 0.100 | 7.750*** | 0.085 | 6.716*** | 0.101 | 1.381*** | 0.119 | 41.688*** | 2.800 |
| Difficulty in taking care of expenses (ref. Yes) | | | | | | | | | | | | | | | | | | | | |
| No | 0.0004 | 0.034 | -1.257* | 0.697 | -0.648* | 0.364 | 0.011 | 0.039 | 1.900** | 0.768 | -0.040 | 0.047 | -0.028 | 0.040 | -0.061 | 0.047 | 0.032 | 0.056 | 1.789 | 1.323 |
| Age (ref. 60–65 years) | | | | | | | | | | | | | | | | | | | | |
| 65–70 years | 0.051*** | 0.019 | -0.269 | 0.402 | -0.057 | 0.210 | 0.033 | 0.022 | 0.714 | 0.445 | 0.058** | 0.027 | 0.047** | 0.023 | 0.058** | 0.027 | -0.003 | 0.033 | -0.291 | 0.773 |
| 70–75 years | 0.076*** | 0.021 | 0.564 | 0.438 | 0.556** | 0.229 | 0.051** | 0.024 | 0.181 | 0.480 | 0.071** | 0.029 | 0.063** | 0.025 | 0.138*** | 0.030 | -0.0004 | 0.035 | -1.121 | 0.836 |
| 75–80 years | 0.085*** | 0.023 | 0.329 | 0.479 | 0.551** | 0.250 | 0.040 | 0.026 | 0.983* | 0.527 | 0.054* | 0.032 | 0.050* | 0.027 | 0.130*** | 0.033 | 0.017 | 0.039 | -0.721 | 0.912 |
| Sex (ref. Male) | | | | | | | | | | | | | | | | | | | | |
| Female | -0.228*** | 0.016 | -3.040*** | 0.329 | -0.987*** | 0.172 | -0.162*** | 0.018 | 4.122*** | 0.363 | -0.209*** | 0.022 | -0.246*** | 0.019 | -0.106*** | 0.022 | 0.236*** | 0.026 | 7.232*** | 0.629 |
| Education (ref. University) | | | | | | | | | | | | | | | | | | | | |
| High school | -0.059*** | 0.016 | 0.552 | 0.343 | 0.390** | 0.179 | -0.054*** | 0.019 | -0.113 | 0.378 | -0.027 | 0.023 | -0.042** | 0.019 | -0.072*** | 0.023 | -0.081*** | 0.028 | -0.617 | 0.656 |
| Elementary | -0.016 | 0.028 | 1.930*** | 0.577 | 1.183*** | 0.302 | -0.008 | 0.032 | 0.046 | 0.634 | 0.015 | 0.039 | 0.019 | 0.033 | -0.020 | 0.040 | -0.119** | 0.047 | -2.191** | 1.105 |
| Civil status (ref. Married) | | | | | | | | | | | | | | | | | | | | |
| Unmarried | -0.017 | 0.021 | -0.445 | 0.433 | 0.023 | 0.226 | -0.004 | 0.024 | 0.827* | 0.480 | -0.008 | 0.029 | 0.006 | 0.025 | -0.036 | 0.029 | -0.089** | 0.035 | -0.832 | 0.826 |
| Widow/er | -0.070*** | 0.026 | -0.119 | 0.526 | 0.035 | 0.275 | -0.081*** | 0.029 | 0.672 | 0.579 | -0.067* | 0.035 | -0.086*** | 0.030 | -0.092** | 0.036 | -0.079* | 0.043 | 1.003 | 1.006 |
| Divorced | -0.024 | 0.022 | -0.732 | 0.461 | -0.335 | 0.241 | -0.007 | 0.026 | 1.583*** | 0.509 | -0.025 | 0.031 | -0.037 | 0.026 | 0.044 | 0.031 | 0.004 | 0.038 | 0.399 | 0.886 |
| Living dependency (ref. Independent) | | | | | | | | | | | | | | | | | | | | |
| Dependent | 0.227 | 0.219 | 2.281 | 4.431 | 1.351 | 2.315 | 0.232 | 0.249 | 1.429 | 4.861 | 0.277 | 0.301 | 0.163 | 0.257 | 0.224 | 0.306 | 0.319 | 0.509 | -4.018 | 8.447 |
| Living alone (ref. No) | | | | | | | | | | | | | | | | | | | | |
| Yes | 0.018 | 0.015 | -0.076 | 0.310 | 0.056 | 0.162 | 0.027 | 0.017 | 0.242 | 0.342 | 0.036* | 0.021 | 0.021 | 0.018 | 0.024 | 0.021 | -0.012 | 0.025 | -0.541 | 0.594 |
| Social group (ref. Blue collar) | | | | | | | | | | | | | | | | | | | | |
| White collar | -0.006 | 0.022 | -0.659 | 0.450 | -0.240 | 0.236 | -0.004 | 0.025 | -0.628 | 0.499 | 0.015 | 0.030 | -0.022 | 0.026 | 0.010 | 0.031 | -0.004 | 0.036 | 2.319*** | 0.860 |
| Entrepreneur | -0.015 | 0.031 | -0.665 | 0.644 | -0.098 | 0.336 | -0.0005 | 0.036 | -1.417** | 0.710 | 0.022 | 0.043 | -0.039 | 0.037 | -0.007 | 0.044 | -0.023 | 0.052 | 2.219* | 1.227 |
| R^2 | 14.5% | | 6.9% | | 4.6% | | 7.0% | | 10.8% | | 7.0% | | 12.3% | | 4.3% | | 5.8% | | 9.5% | |

E%, percentage of energy; CHO, carbohydrate; F&V, fruits and vegetables; DQI, Diet Quality Index; CU, consumption unit; ref., reference category.

***Statistically significant at 1% level; **statistically significant at 5% level; *statistically significant at 10% level; coefficients of regional dummy variables not reported.

The statistical results also establish that, once income and education are controlled for, the socio-professional status of the elderly does not correlate with diet quality in a clear manner. In the UK, active managers adopt relatively healthier diets than pensioners, but there is no statistically significant difference in diet quality between pensioners and the other socio-professional categories (employees, self-employed). Besides, a different relationship is observed in the Italian sample, where managers are found to choose diets of relatively poorer quality than pensioners. For Finland, none of the coefficients of the four dummy variables describing the socio-professional status of the household is significant. The results of the regression models for the Swedish sample are interpreted slightly differently as the socio-professional status describes the situation of the elderly person prior to retirement, with blue collar workers used as the reference group. It is found there that the elderly belonging to the white collar and entrepreneur categories make healthier food choices than those in the blue collar category.

The regression models indicate that in three of the four countries studied, household structure correlates significantly with diet quality: the elderly living alone make relatively less healthy food choices than elderly couples. The result is explained by different aspects of the diets in the three samples, with only the larger consumption of protein by those living alone showing consistency across the three countries. In Sweden, diet quality of those living alone is also found to be relatively poorer, but the effect is small and not statistically significant.

The impact of gender is most easily assessed in the Swedish sample because of the individual (rather than household) nature of the data and it is found that women make healthier food choices than men, the difference in diet quality score between the two groups being both large and statistically significant. This is explained by better nutrition in almost all dimensions of the DQI for women than for men: better macronutrient mix of the energy ingested (relatively more carbohydrate and less fat and saturated fat for women), lower intakes of cholesterol and sodium, as well as greater intakes of fruits and vegetables. The effect of gender is not systematically measurable in the data sets for the UK, Finland, and Italy, but valuable insights can nevertheless be derived by comparing the coefficients of the dummy variables for men living alone and women living alone. In all three cases, and in line with the Swedish results, this comparison leads to the conclusion that men make less healthy food choices than women. The reasons vary but, overall, there is evidence that, relative to men, elderly females tend to consume less protein, cholesterol and sodium while deriving a larger share of their energy from carbohydrate and consuming more fruits and vegetables.

Age is not statistically significant in explaining diet quality in the British, Italian and Swedish samples. In the

Finnish case, the relationship with age is not very robust either, as only the coefficient corresponding to the 75–80 years age range is significant, and we can conclude overall a limited influence of age on the healthiness of the food choices made by the elderly.

Tables 3–6 also provide information about the effect of some general control variables on diet quality. First, in all three countries where the nature of the data permits the analysis of potential regional effects, these are found to be significant. Hence, diets in the northern and eastern regions of Finland are found to be significantly healthier than in the south of the country; in Italy, the analysis indicates relatively better diets in the North-East and Central regions, and relatively more unhealthy food choices among the elderly in the South. In the UK, the diets of the elderly in London, the South-East, West Midlands, Scotland and Northern Ireland are relatively healthier than the diets adopted by the elderly in the North East. Next, the influence of seasonality is not found to be significant in the UK, but in Finland the elderly appear to make food choices of relatively poorer nutritional quality during the fourth quarter of the year. Finally, in an attempt to detect potential structural changes in food preferences among the elderly, the influence of the year of data collection is analysed. In Finland, once accounting for the other sociodemographic variables, no such fundamental difference in diet quality is found between the two rounds of the survey (1998 and 2006). In the UK, the elderly adopt relatively less healthy diets in 2007 than in 2006, but the short time span separating the two rounds of the survey does not allow us to conclude that the difference reflects a fundamental, continuous and worrying evolution.

The robustness of the results has been assessed by estimating different specifications of the model, as reported in the Appendix in the case of the Finnish model. Given the rather unexpected result of a negative relationship between resource availability and diet quality, we used several proxies to measure the former: total consumption expenditure per consumption unit and share of expenditure allocated to food (baseline model); total income per consumption unit (income model); and total expenditure alone (expenditure only model). In addition, the sample was also restricted by raising the age limit of eligible individuals to 65 years (65+ model) and a model controlling for total energy intake per capita was also estimated (energy model). Although the explanatory power of the model varies a great deal across specifications, most results appear robust and, in particular, resource availability is found to affect diet quality negatively for all the variants of the Finnish model. The sensitivity analysis for other countries was less thorough because of data limitations – for instance, there is no income variable in any of the other data sets – but confirmed overall the robustness of the results.

Discussion and conclusion

The finding that the variables resource availability and preference for food either influence diet quality negatively (in the case of the UK and Finland) or in a non-significant or non-linear way (in the case of Italy and Sweden) stands in sharp contrast with the predominant view in the public health literature that many individuals have few options but to make unhealthy food choices because of limited resources. Although not specifically for the elderly, this idea is for instance articulated by Drewnowski and Darmon⁽¹⁵⁾, who consider that obesity in the USA is largely an economic issue explained by growing disparities in income, the declining value of the minimum wage and the relatively low price of energy-dense but nutrient-poor foods compared with healthier alternatives. According to that logic, and given that the elderly in industrialised countries tend to have lower incomes and face a greater risk of relative poverty than the rest of the population, one would expect financial resources to influence diet quality positively among the elderly, but our analysis does not support that proposition. Instead, the empirical findings related to the resource availability, preference for food and even education variables appear more consistent with the view that poor diet quality among the elderly represents a 'challenge of affluence', as proposed by Offer⁽¹⁶⁾ to describe the disorders of self-control and lack of rationality of the choices that accompany growing prosperity.*

Albeit unexpected, this conclusion is rather encouraging regarding the potential of specific public health policies, as opposed to general economic ones, to improve the nutritional health of the elderly population. In particular, if poor diet quality results from the elderly's inability to appreciate the future benefits of healthy food choices, informational measures explaining those benefits more clearly may be successful in improving diet healthiness. This remains a hypothesis requiring further examination, however, because the data do not provide any measure of nutritional knowledge of the surveyed individuals.

We also note that other empirical results reported in the literature are consistent with a non-positive relationship between nutritional health and economic resources. For example, Cawley *et al.*⁽¹⁸⁾ used a natural experiment to conclude that income had no effect on the weight of elderly Americans. For the general US population, Variyam and Blaylock⁽¹⁹⁾ found that income was negatively associated with diet quality after controlling for other socio-demographic variables because of a link between income and preferences for convenience foods, dining out and more expensive, fat-rich foods. For the same US population, Popkin *et al.*⁽²⁰⁾ compared dietary surveys from 1965 and 1996 to conclude the absence of any consistent and

significant effect of income on diet quality. Less surprising because of the lower development level of the country, Du *et al.*⁽²¹⁾ found that rapid economic growth in China adversely affected diet quality. While these findings do not relate specifically to elderly Europeans, they point to the plausibility of our conclusion regarding the non-positive effect of resource availability on diet quality.

The estimations also support the view that food choices are largely set in those over the age of 50 years, perhaps as the result of habits contracted throughout life. In particular, retirement does not come out in the data as a major life event which, perhaps because of its impact on social networks or the opportunity cost of time, brings about a structural change in the elderly's food choices. Further, the fact that the age variable does not explain diet quality much suggests that the physiological and functional changes normally associated with ageing (e.g. changes in gustatory and olfactory functions, masticatory efficiency and mobility) cannot be regarded as the main drivers of diet quality among the elderly, at least at the population level.

If food choices and diet quality appear to be fairly stable in the over-50s age group, the analysis also reveals great inter-individual heterogeneity which is only partially explained by socio-economic variables. The finding that educational level, being a female and not living alone are positively associated with diet quality is largely in line with previous studies. For instance, in a European context, the Swedish case study of Gustavsson and Sidenvall⁽²²⁾ found that women living alone were more likely to simplify meals and, as a result, adopt diets of relatively poor quality. Meanwhile, the UK study of Donkin *et al.*⁽²³⁾ concluded that the salient question to explain intakes of fruits and vegetables was 'is there a woman in the household?' Although few studies have investigated the influence of education on the food choices of the elderly, our findings are also consistent with the robust 'education gradient', which describes the positive relationship between education and health for the general population⁽²⁴⁾.

Finally, it is important to point to some limitations of the study. The secondary data sets did not provide information on some potentially important determinants of food choices and diet quality, which were consequently omitted from the analysis. For instance, it is difficult to conclude whether availability and access to healthy foods are important drivers of diet quality among the EU elderly, although the evidence related to the seasonality and age variables suggests, indirectly, otherwise. More serious is the omission of health status, which influences food choices and diet quality, as with diabetics urged by their physician to make specific dietary adjustments in order to manage their disease. Although some of the data included information on health status, the variable was nevertheless omitted because it is itself influenced by diet quality and therefore cannot be treated as an ordinary variable in multivariate regression analysis.† While possible,

* This view is summarised and extended in the book review of Oswald and Powdthavee⁽¹⁷⁾.

† Otherwise the results are subject to the 'ecological fallacy'⁽²⁵⁾.

statistical modelling of the bidirectional causal relationship between diet quality and health is difficult and left to further research.

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Appendix

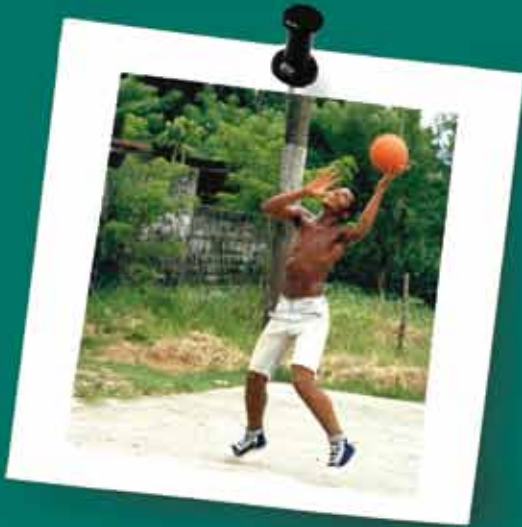
Sensitivity analysis, Finnish results

| | Baseline model | | Income model | | Expenditure only model | | Energy model | | 65+ model | |
|---------------------------------|----------------|-------|--------------|-------|------------------------|-------|--------------|-------|------------|-------|
| | β | SE | β | SE | β | SE | β | SE | β | SE |
| Constant | 123.200*** | 6.875 | 50.220*** | 6.996 | 75.310*** | 6.193 | 130.900*** | 6.910 | 112.900*** | 6.686 |
| Log (total expenditure/CU) | -8.020*** | 0.673 | - | - | -4.046*** | 0.637 | -6.230*** | 0.743 | -7.010*** | 0.667 |
| Food share of expenditure | -5.290*** | 3.634 | - | - | - | - | -40.800*** | 4.197 | -46.400*** | 3.656 |
| Log (income/CU) | - | - | -1.390* | 0.714 | - | - | - | - | - | - |
| Log (total energy per capita) | - | - | - | - | - | - | -3.490*** | 0.396 | - | - |
| Household type (ref. Couple) | | | | | | | | | | |
| Male alone | -2.040** | 0.832 | 0.292 | 0.866 | -0.049 | 0.800 | -1.520* | 0.827 | -0.570 | 1.184 |
| Female alone | -1.390** | 0.622 | -0.120 | 0.659 | -0.336 | 0.634 | -0.950 | 0.617 | -1.500* | 0.782 |
| Education (ref. Primary) | | | | | | | | | | |
| Secondary | 0.785 | 0.636 | 0.625 | 0.664 | 0.827 | 0.658 | 0.829 | 0.627 | 0.328 | 0.626 |
| Tertiary | 1.785** | 0.700 | 1.428* | 0.747 | 2.289*** | 0.724 | 1.748** | 0.692 | 1.609** | 0.696 |
| Social group (ref. Pensioner) | | | | | | | | | | |
| Entrepreneur | 0.773 | 1.131 | 0.166 | 1.181 | 0.766 | 1.171 | 0.998 | 1.116 | -0.230 | 1.085 |
| White collar | 1.164 | 0.918 | 1.192 | 0.969 | 1.465 | 0.950 | 0.972 | 0.905 | -0.700 | 0.781 |
| Blue collar | -1.110 | 1.034 | -1.120 | 1.085 | -1.041 | 1.072 | -1.010 | 1.017 | -3.040*** | 0.902 |
| Other | -0.380 | 1.390 | 0.621 | 1.456 | 0.184 | 1.448 | -0.050 | 1.377 | -2.020 | 1.307 |
| Age (ref. 50–54 or 65–69 years) | | | | | | | | | | |
| 55–60 years | 0.500 | 0.912 | 0.314 | 0.952 | 0.110 | 0.948 | 0.862 | 0.900 | - | - |
| 60–65 years | 1.064 | 0.968 | 0.942 | 1.009 | 0.656 | 1.003 | 1.607* | 0.956 | - | - |
| 65–70 years | 1.499 | 1.129 | 1.955* | 1.174 | 1.354 | 1.169 | 2.027* | 1.114 | - | - |
| 70–75 years | 1.711 | 1.191 | 1.953 | 1.236 | 1.243 | 1.233 | 2.398** | 1.176 | 1.379* | 0.793 |
| 75–80 years | 3.251** | 1.271 | 3.943*** | 1.315 | 2.934** | 1.315 | 3.745*** | 1.254 | 3.086*** | 0.923 |
| >80 years | 1.827 | 1.307 | 3.766*** | 1.349 | 2.646* | 1.351 | 2.802** | 1.297 | 2.290** | 1.008 |
| Year (ref. 2007) | 0.422 | 0.518 | 0.188 | 0.568 | 0.580 | 0.536 | -0.190 | 0.516 | 0.097 | 0.512 |
| Quarter (ref. Quarter 4) | | | | | | | | | | |
| Quarter 1 | 1.401** | 0.686 | 1.658** | 0.714 | 1.559** | 0.710 | 1.628** | 0.678 | 1.607** | 0.683 |
| Quarter 2 | 1.262* | 0.659 | 0.906 | 0.687 | 0.999 | 0.681 | 1.512** | 0.651 | 1.442** | 0.655 |
| Quarter 3 | 1.740** | 0.678 | 1.781** | 0.706 | 1.725** | 0.701 | 2.274*** | 0.671 | 2.380*** | 0.674 |
| Region (ref. South) | | | | | | | | | | |
| West | 0.065 | 0.608 | 0.096 | 0.633 | -0.181 | 0.642 | 0.130 | 0.601 | 0.080 | 0.605 |
| East | 1.225* | 0.720 | 1.548** | 0.748 | 1.066 | 0.744 | 1.232* | 0.710 | 1.251* | 0.715 |
| North | 1.916** | 0.832 | 1.869** | 0.867 | 1.599* | 0.861 | 1.833** | 0.820 | 1.933** | 0.822 |
| Åland | 1.400 | 1.480 | 1.346 | 1.542 | 1.532 | 1.532 | 1.458 | 1.478 | 1.818 | 1.482 |
| R^2 | 9.5% | | 1.9% | | 3.1% | | 13.3% | | 9.1% | |

CU, consumption unit; ref., reference category.

***Statistically significant at 1% level; **statistically significant at 5% level; *statistically significant at 10% level.

GLOBAL RECOMMENDATIONS ON PHYSICAL ACTIVITY FOR HEALTH



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LIST OF ABBREVIATIONS

AFRO: WHO Regional Office for Africa
AMRO/ PAHO: WHO Regional Office for the Americas
CDC: Centres for Disease Control and Prevention
CHD: Coronary Heart Disease
CVD: Cardio Vascular Disease
DPAS: Global Strategy on Diet, Physical Activity & Health
EMRO: WHO Regional Office for the Eastern Mediterranean
EURO: WHO Regional Office for Europe
GPAQ: Global Physical Activity Questionnaire
GSHS: Global School-based Health Survey
GRC: Guidelines Review Committee
HQ: Headquarters
LMIC: Low- and Middle-Income Countries
NCDs: Non-communicable Diseases
PA: Physical Activity
RO: Regional Officer
S: Strong Recommendation (WHO Guidelines Review Committee Definition)
SEARO: WHO Regional Office for South-East Asia
STEPS: The WHO STEPwise approach to Surveillance
W: Weak Recommendation (WHO Guidelines Review Committee Definition)
WHO: World Health Organization
WPRO: WHO Regional Office for the Western Pacific

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1. EXECUTIVE SUMMARY

Physical inactivity is now identified as the fourth leading risk factor for global mortality. Physical inactivity levels are rising in many countries with major implications for the prevalence of noncommunicable diseases (NCDs) and the general health of the population worldwide.

The significance of physical activity on public health, the global mandates for the work carried out by WHO in relation to promotion of physical activity and NCDs prevention, and the limited existence of national guidelines on physical activity for health in low- and middle-income countries (LMIC) make evident the need for the development of global recommendations that address the links between the frequency, duration, intensity, type and total amount of physical activity needed for the prevention of NCDs.

The focus of the *Global Recommendations on Physical Activity for Health* is primary prevention of NCDs through physical activity at population level, and the primary target audience for these Recommendations are policy-makers at national level.

Issues not addressed in this document are clinical control and the management of disease through physical activity. Guidance on how to develop interventions and approaches to promote physical activity in population groups are similarly not addressed.

The following steps summarize the process undertaken by the WHO Secretariat in preparation of the *Global Recommendations on Physical Activity for Health*:

1. Review and compilation of the scientific evidence available for three age groups, for the following outcomes: cancer, cardiorespiratory, metabolic, musculoskeletal and functional health.
2. Setting out of a process to develop the Recommendations.
3. Establishment of a global guideline group with expertise both in subject matter and in policy development and implementation.
4. Meeting and electronic consultation of the guideline group to prepare the final draft of the *Global Recommendations on Physical Activity for Health*.
5. Peer review of the Recommendations and consultation with the WHO Regional Offices.
6. Finalization of the Recommendations, approval by the WHO Guideline Review Committee.
7. Translation, publication and dissemination.

The recommendations set out in this document address three age groups: 5–17 years old; 18–64 years old; and 65 years old and above. A section focusing on each age group includes the following:

- a narrative summary of scientific evidence;
- the current physical activity recommendations;
- the interpretation and justification for the recommendations made.

RECOMMENDED LEVELS OF PHYSICAL ACTIVITY FOR HEALTH

5–17 years old

For children and young people of this age group physical activity includes play, games, sports, transportation, recreation, physical education or planned exercise, in the context of family, school, and community activities. In order to improve cardiorespiratory and muscular fitness, bone health, cardiovascular and metabolic health biomarkers and reduced symptoms of anxiety and depression, the following are recommended:

1. Children and young people aged 5–17 years old should accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity daily.
2. Physical activity of amounts greater than 60 minutes daily will provide additional health benefits.
3. Most of daily physical activity should be aerobic. Vigorous-intensity activities should be incorporated, including those that strengthen muscle and bone, at least 3 times per week.



18–64 years old

For adults of this age group, physical activity includes recreational or leisure-time physical activity, transportation (e.g walking or cycling), occupational (i.e. work), household chores, play, games, sports or planned exercise, in the context of daily, family, and community activities.

In order to improve cardiorespiratory and muscular fitness, bone health and reduce the risk of NCDs and depression the following are recommended:

1. Adults aged 18–64 years should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week, or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity.
2. Aerobic activity should be performed in bouts of at least 10 minutes duration.
3. For additional health benefits, adults should increase their moderate-intensity aerobic physical activity to 300 minutes per week, or engage in 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate- and vigorous-intensity activity.
4. Muscle-strengthening activities should be done involving major muscle groups on 2 or more days a week.

65 years old and above

For adults of this age group, physical activity includes recreational or leisure-time physical activity, transportation (e.g walking or cycling), occupational (if the person is still engaged in work), household chores, play, games, sports or planned exercise, in the context of daily, family, and community activities.

In order to improve cardiorespiratory and muscular fitness, bone and functional health, and reduce the risk of NCDs, depression and cognitive decline, the following are recommended:

1. Adults aged 65 years and above should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week, or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity.
2. Aerobic activity should be performed in bouts of at least 10 minutes duration.
3. For additional health benefits, adults aged 65 years and above should increase their moderate-intensity aerobic physical activity to 300 minutes per week, or engage in 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate- and vigorous-intensity activity.
4. Adults of this age group with poor mobility should perform physical activity to enhance balance and prevent falls on 3 or more days per week.
5. Muscle-strengthening activities should be done involving major muscle groups, on 2 or more days a week.
6. When adults of this age group cannot do the recommended amounts of physical activity due to health conditions, they should be as physically active as their abilities and conditions allow.

Overall, across all the age groups, the benefits of implementing the above recommendations, and of being physically active, outweigh the harms. At the recommended level of 150 minutes per week of moderate-intensity activity, musculoskeletal injury rates appear to be uncommon. In a population-based approach, in order to decrease the risks of musculoskeletal injuries, it would be appropriate to encourage a moderate start with gradual progress to higher levels of physical activity.



2

PHYSICAL ACTIVITY FOR HEALTH



2.1 PUBLIC HEALTH SIGNIFICANCE OF PHYSICAL ACTIVITY

Physical inactivity has been identified as the fourth leading risk factor for global mortality (6% of deaths globally). This follows high blood pressure (13%), tobacco use (9%) and high blood glucose (6%). Overweight and obesity are responsible for 5% of global mortality (1).

Levels of physical inactivity are rising in many countries with major implications for the general health of people worldwide and for the prevalence of NCDs such as cardiovascular disease, diabetes and cancer and their risk factors such as raised blood pressure, raised blood sugar and overweight. Physical inactivity is estimated as being the principal cause for approximately 21–25% of breast and colon cancer burden, 27% of diabetes and approximately 30% of ischaemic heart disease burden (1). In addition, NCDs now account for nearly half of the overall global burden of disease. It is estimated currently that of every 10 deaths, 6 are attributable to noncommunicable conditions (2).

Global health is being influenced by three trends: population-ageing, rapid unplanned urbanization, and globalization, all of which result in unhealthy environments and behaviours. As a result, the growing prevalence of NCDs and their risk factors has become a global issue affecting both low- and middle-income countries. Nearly 45% of the adult disease burden in these countries is now attributable to NCDs. Many low- and middle-income countries are beginning to suffer the double burden of communicable and noncommunicable diseases, and health systems in these countries are now having to cope with the additional costs of treating both.

It has been shown that participation in regular physical activity reduces the risk of coronary heart disease and stroke, diabetes, hypertension, colon cancer, breast cancer and depression. Additionally, physical activity is a key determinant of energy expenditure, and thus is fundamental to energy balance and weight control (1–6).

2.2 MANDATE ON PHYSICAL ACTIVITY FOR HEALTH

In May 2004, the Fifty-seventh World Health Assembly endorsed Resolution WHA57.17: *Global Strategy on Diet, Physical Activity and Health* and recommended that Member States develop national physical activity action plans and policies to increase physical activity levels in their populations (5). Furthermore, in May 2008, the Sixty-first World Health Assembly endorsed Resolution WHA61.14: *Prevention and Control of Noncommunicable Diseases: Implementation of the Global Strategy and the Action Plan for the Global Strategy for the Prevention and Control of Noncommunicable Diseases* (7).

This Action Plan urges Member States to implement national guidelines on physical activity for health and encourages them to develop and put into practice policies and interventions that:

- develop and implement national guidelines on physical activity for health;
- introduce transport policies that promote active and safe methods of travelling to and from schools and workplaces, such as walking or cycling;
- ensure that physical environments support safe active commuting, and create space for recreational activity.

The action plan urges WHO to provide countries with technical support in either implementing or strengthening nationwide actions to reduce risk factors for NCDs.

2.3 IMPORTANCE OF NATIONAL AND REGIONAL PHYSICAL ACTIVITY GUIDELINES

The limited existence of national guidelines on physical activity for health in low- and middle-income countries, the public health significance of physical activity and the global mandates for the work of WHO, related to promotion of physical activity and NCD prevention, make evident the need for the development of global recommendations that address the links between the frequency, duration, intensity, type and total amount of physical activity needed for the prevention of NCDs.

Scientifically-informed recommendations, with a global scope, on the benefits, type, amount, frequency, intensity, duration and total amount of the physical activity necessary for health benefits are key information for policy-makers wanting to address physical activity at population level and who are involved in the development of guidelines and policies at regional and national levels on prevention and control of NCDs.

The development and publication of science-based national or regional physical activity guidelines can:

- inform national physical activity policies and other public health interventions;
- provide the starting point to the establishment of goals and objectives for physical activity promotion at national level;
- foster intersectoral collaboration and contribute to setting up national goals and objectives regarding physical activity promotion;
- provide a foundation for physical activity promotion initiatives;
- justify the allocation of resources to physical activity promotion interventions;
- create a framework for joint action for all other relevant stakeholders around the same goal;
- provide an evidence-based document that enables all relevant stakeholders to transfer policy into action with the allocation of the appropriate resources; and
- facilitate national surveillance and monitoring mechanisms to monitor population levels of physical activity.



3

DEVELOPMENT OF THE GLOBAL RECOMMENDATIONS ON PHYSICAL ACTIVITY FOR HEALTH

3.1 SCOPE AND TARGET AUDIENCE

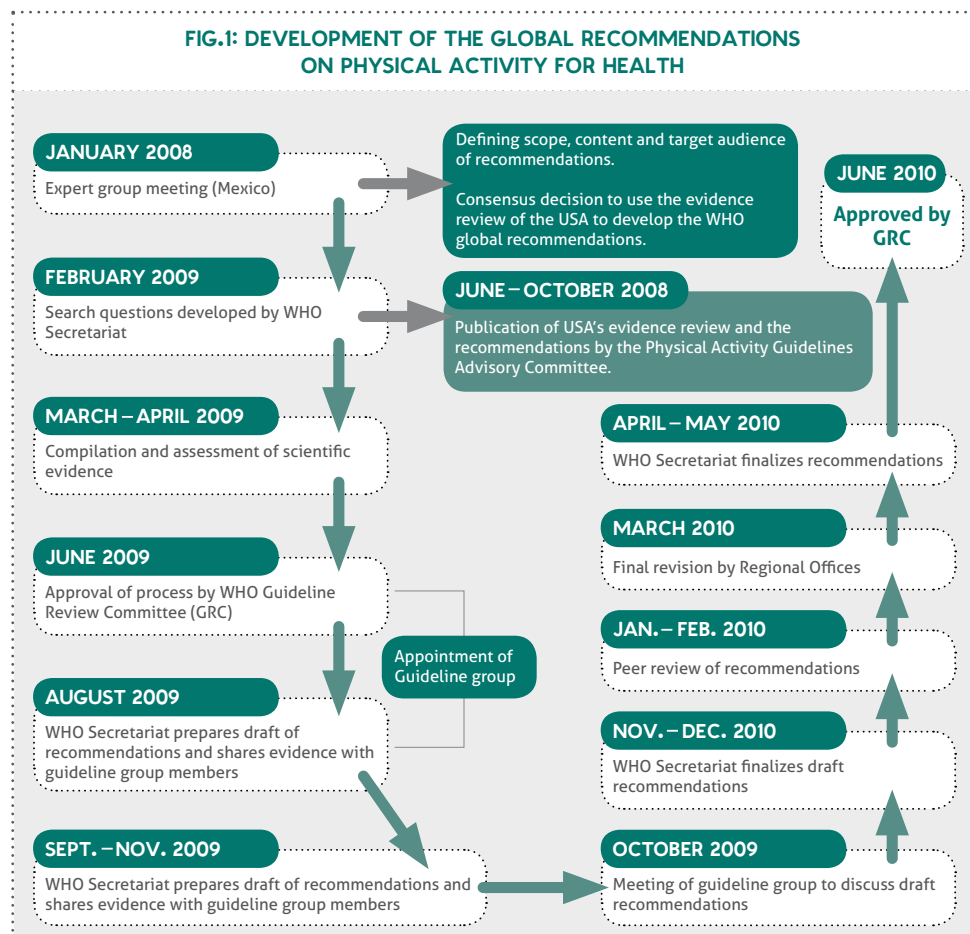
The *Global Recommendations on Physical Activity for Health* aim to provide guidance on the dose-response relationship between physical activity and health benefits (i.e. the frequency, duration, intensity, type and total amount of physical activity needed for health enhancement and prevention of NCDs). The primary prevention of NCDs through physical activity, at population level, is the focus of this document, while the management of disease through physical activity, and clinical control are not addressed.

By reviewing the evidence and compiling it in the format of recommendations on the frequency, duration, intensity, type and total amount of physical activity to be achieved at the population level, this document aims to assist policy-makers in the development of public health policies. National-level policy-makers are the primary target audience of these recommendations, as these are expected to constitute a resource for them in the development of national guidelines for health-enhancing physical activity.

Guidance on how to develop interventions and approaches to promote physical activity in population groups is an issue that is not addressed in the document. However, information for this can be found in the publication: *A guide for population-based approaches to increasing levels of physical activity: implementation of the Global Strategy on Diet, Physical Activity and Health* (3).

3.2 DEVELOPMENT PROCESS

The Recommendations set out in this document were developed according to the process outlined in the figure below. A detailed description of the methodology used for developing the *Global Recommendations on Physical Activity for Health* is included in Appendix 1.





4

RECOMMENDED POPULATION LEVELS
OF PHYSICAL ACTIVITY FOR HEALTH

4.1 INTRODUCTION

The following section presents the recommended levels of physical activity for three age groups: 5–17 years old, 18–64 years old and 65 years old and above. These age groups were selected taking into consideration the nature and availability of the scientific evidence relevant to the selected outcomes. The recommendations do not address the age group of children less than 5 years old. Although children in this age range benefit from being active, more research is needed to determine what dose of physical activity provides the greatest health benefits.

Each section includes:

- remarks on the target population;
- a narrative summary of the scientific evidence;
- the recommendations on physical activity for health; and
- the interpretation and justification for the recommendations presented.

The *Global Recommendations on Physical Activity for Health* are relevant for the following health outcomes:

- Cardiorespiratory health (coronary heart disease, cardiovascular disease, stroke and hypertension).
- Metabolic health (diabetes and obesity).
- Musculoskeletal health (bone health, osteoporosis).
- Cancer (breast and colon cancer).
- Functional health and prevention of falls.
- Depression.

The recommendations presented in this document use the concepts of frequency, duration, intensity, type and total amount of physical activity needed for health enhancement and prevention of NCDs. Box 1 includes definitions of these and other useful concepts. Further information can be found in the Glossary in Appendix 5.

BOX 1: DEFINITIONS OF CONCEPTS USED IN THE RECOMMENDED LEVELS OF PHYSICAL ACTIVITY

Type of physical activity (What type). The mode of participation in physical activity. The type of physical activity can take many forms: aerobic, strength, flexibility, balance.

Duration (For how long). The length of time in which an activity or exercise is performed. Duration is generally expressed in minutes.

Frequency (How often). The number of times an exercise or activity is performed. Frequency is generally expressed in sessions, episodes, or bouts per week.

Intensity (How hard a person works to do the activity). Intensity refers to the rate at which the activity is being performed or the magnitude of the effort required to perform an activity or exercise.

Volume (How much in total). Aerobic exercise exposures can be characterized by an interaction between bout intensity, frequency, duration, and longevity of the programme. The product of these characteristics can be thought of as volume.

Moderate-intensity physical activity. On an absolute scale, moderate intensity refers to activity that is performed at 3.0–5.9 times the intensity of rest. On a scale relative to an individual's personal capacity, moderate-intensity physical activity is usually a 5 or 6 on a scale of 0–10.

Vigorous-intensity physical activity. On an absolute scale, vigorous intensity refers to activity that is performed at 6.0 or more times the intensity of rest for adults and typically 7.0 or more times for children and youth. On a scale relative to an individual's personal capacity, vigorous-intensity physical activity is usually a 7 or 8 on a scale of 0–10.

Aerobic activity. Aerobic activity, also called endurance activity, improves cardiorespiratory fitness. Examples of aerobic activity include: brisk walking, running, bicycling, jumping rope, and swimming.



AGE GROUP: 5 - 17 YEARS OLD



TARGET POPULATION

These guidelines are relevant to all children aged 5–17 years unless specific medical conditions indicate to the contrary. Children and youth should be encouraged to participate in a variety of physical activities that support the natural development and are enjoyable and safe.

Whenever possible, children and youth with disabilities should meet these recommendations. However they should work with their health care provider to understand the types and amounts of physical activity appropriate for them considering their disability.

These recommendations are applicable for all children and youth irrespective of gender, race, ethnicity, or income level. However the communication strategies, dissemination and messaging of the recommendations may differ so as to be most effective in various population subgroups.

The recommended levels of physical activity for children and youth included in this section, should be achieved above and beyond the physical activity accumulated in the course of normal daily non-recreational activities.

All children and youth should be physically active daily as part of play, games, sports, transportation, recreation, physical education, or planned exercise, in the context of family, school, and community activities.

For inactive children and youth, a progressive increase in activity to eventually achieve the target shown below is recommended. It is appropriate to start with smaller amounts of physical activity and gradually increase duration, frequency and intensity over time. It should also be noted that if children are currently doing no physical activity, doing amounts below the recommended levels will bring more benefits than doing none at all.

NARRATIVE SUMMARY OF SCIENTIFIC EVIDENCE (9–11)

The scientific evidence available for the age group 5–17 years supports the overall conclusion that physical activity provides fundamental health benefits for children and youth. This conclusion is based on findings of observational studies in which higher levels of physical activity were found to be associated with more favourable health parameters as well as experimental studies in which physical activity interventions were associated with improvements in health indicators. The documented health benefits include increased physical fitness (both cardiorespiratory fitness and muscular strength), reduced body fatness, favourable cardiovascular and metabolic disease risk profiles, enhanced bone health and reduced symptoms of depression. (9-11)

Physical activity is positively related to cardiorespiratory and metabolic health in children and youth. To examine the relation between physical activity and cardiovascular and metabolic health, the guideline group reviewed literature from the CDC Literature review (2008) and the evidence reviews from Janssen (2007) and Janssen, Leblanc (2009). (9-11)

A dose-response relationship appears to exist, in that greater doses of physical activity are associated with improved indicators of cardiorespiratory and metabolic health. Taken together, the observational and experimental

evidence supports the hypothesis that maintaining high amounts and intensities of physical activity starting in childhood and continuing into adult years will enable people to maintain a favourable risk profile and lower rates of morbidity and mortality from cardiovascular disease and diabetes later in life. Collectively, the research suggests that moderate- to vigorous-intensity physical activity for at least 60 minutes per day would help children and youth maintain a healthy cardiorespiratory and metabolic risk profile. In general it appears that higher volumes or intensities of physical activity are likely to have greater benefit, but research in this area is still limited. (9-11)

Physical activity is positively related to cardiorespiratory fitness in children and youth, and both preadolescents and adolescents can achieve improvements in cardiorespiratory fitness with exercise training. In addition, physical activity is positively related to muscular strength. In both children and youth, participation in muscle-strengthening activities 2 or 3 times per week significantly improves muscular strength. For this age group, muscle-strengthening activities can be unstructured and part of play, such as playing on playground equipment, climbing trees or pushing and pulling activities. (9-11)

Normal-weight youth who have relatively high levels of physical activity tend to have less adiposity than youth with low levels. Among overweight and obese youth, interventions that increase the levels of physical activity tend to show beneficial effects on health.

Bone-loading physical activity increases bone mineral content and bone density. Targeted weight-loading activities that simultaneously influence muscular strength, performed 3 or more days per week are effective. For this age group, bone-loading activities can be performed as part of playing games, running, turning or jumping. The literature used for the rationale and dose-response pattern related to bone health was obtained from the CDC literature review (2008), and the evidence reviews from Janssen (2007) and Janssen, Leblanc (2009). (9-11)

The review of the literature relating muscular strength to the relation and dose-response pattern included literature from the CDC literature review (2008), and the evidence reviews from Janssen (2007) and Janssen, Leblanc (2009).

An overall evaluation of the evidence suggests that important health benefits can be expected to accrue in most children and youth who accumulate 60 or more minutes of moderate to vigorous physical activity daily. (9-11)

The concept of accumulation refers to meeting the goal of 60 minutes per day by performing activities in multiple shorter bouts spread throughout the day (e.g. 2 bouts of 30 minutes), then adding together the time spent during each of these bouts. Furthermore, certain specific types of physical activity must be included in an overall physical activity pattern in order for children and youth to gain comprehensive health benefits (9-11).



These include regular participation in each of the following types of physical activity on 3 or more days per week:

- resistance exercise to enhance muscular strength in the large muscle groups of the trunk and limbs;
- vigorous aerobic exercise to improve cardiorespiratory fitness, cardiovascular risk factors and other metabolic disease risk factors; weight-loading activities to promote bone health.

These specific types of physical activity can be integrated to achieve 60 minutes or more per day of health and fitness promoting activity.

A detailed reference of the literature used by the guidelines group to develop these recommendations can be found in Appendix 2.

RECOMMENDATIONS

For children and young people, physical activity includes play, games, sports, transportation, recreation, physical education, or planned exercise, in the context of family, school and community activities.

The guidelines group reviewed the above cited literature and recommended that in order to improve cardiorespiratory and muscular fitness, bone health, cardiovascular and metabolic health biomarkers and reduce symptoms of anxiety and depression:

- 1. Children and youth aged 5–17 should accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity daily.**
- 2. Amounts of physical activity greater than 60 minutes provide additional health benefits.**
- 3. Most of the daily physical activity should be aerobic. Vigorous-intensity activities should be incorporated, including those that strengthen muscle and bone, at least 3 times per week.**

INTERPRETATION AND JUSTIFICATION

There is conclusive evidence that the physical fitness and health status of children and youth are substantially enhanced by frequent physical activity. Compared to inactive young people, physically active children and youth have higher levels of cardiorespiratory fitness, muscular endurance and muscular strength, and well-documented health benefits include reduced body fat, more favourable cardiovascular and metabolic disease risk profiles, enhanced bone health, and reduced symptoms of anxiety and depression.

Aerobic-type activities should make up the majority of the daily discretionary physical activity.

These recommendations represent a minimum target for daily physical activity that allows for health enhancement and prevention of NCDs.

The costs of adopting these recommendations are minimal and essentially related to the translation into country settings, communication and dissemination. Implementation of comprehensive policies that facilitate the achievement of the recommended levels of physical activity will require additional resource investment.

The benefits of being physically active and implementing the above recommendations outweigh the harms. Any existing risk can be significantly reduced by a progressive increase in the activity level, especially in children who are inactive.

In order to reduce the risk of injuries, the use of protective equipment, such as helmets, should be encouraged in all types of activity that can potentially pose these risks (12).

It should be noted that in populations that are already active, the national physical activity guidelines should not promote a physical activity target that would encourage a reduction in current levels.



AGE GROUP: 18 - 64 YEARS OLD



TARGET POPULATION

These guidelines are relevant to all healthy adults aged 18–64 years unless specific medical conditions indicate to the contrary. The guidelines also apply to individuals in this age range with chronic noncommunicable conditions not related to mobility such as hypertension or diabetes. Pregnant, postpartum women and persons with cardiac events may need to take extra precautions and seek medical advice before striving to achieve the recommended levels of physical activity for this age group.

Inactive adults or adults with disease limitations will have added health benefits if moving from the category of “no activity” to “some levels” of activity. Adults who currently do not meet the recommendations for physical activity should aim to increase duration, frequency and finally intensity as a target to achieving the recommended guidelines.

These recommendations are applicable for all adults irrespective of gender, race, ethnicity or income level. However, to be most effective, the type of physical activity, the communication strategies, dissemination and messaging of the recommendations, may differ in various population groups. The retirement age, which varies from country to country, should also be taken into consideration when implementing interventions to promote physical activity.

These recommendations can be applied to adults with disabilities. However they may need to be adjusted for each individual based on their exercise capacity and specific health risks or limitations.

NARRATIVE SUMMARY OF SCIENTIFIC EVIDENCE (11, 13–19)

The review of the literature relating cardiorespiratory fitness, muscular strength, metabolic health and bone health to the rationale for relation and dose response patterns was based on an evaluation from the CDC literature review (2008), the evidence reviews from Warburton et al (2007 and 2009) and the review by Bauman et al (2005). (11, 13–19)

The dose-response pattern related to depression was reviewed from the CDC literature review (2008). (11)

There is a direct relationship between physical activity and cardiorespiratory health (risk reduction of CHD, CVD, stroke, hypertension). Physical activity improves cardiorespiratory fitness. Fitness has direct dose-response relations between intensity, frequency, duration and volume. There is a dose-response relation for CVD and CHD. Risk reductions routinely occur at levels of 150 minutes of at least moderate-intensity activity per week. (11, 13–19)

Literature from Cook (2008) and Steyn (2005) related to The INTERHEART Africa Study and Nocon (2008) and Sofi (2008) related to cardiovascular disease and mortality were also considered during the peer review process and related specifically to the context of Africa and cardiovascular disease. (14–17)

There is a direct relationship between physical activity and metabolic health, including reduction of risk of diabetes and metabolic syndrome (11, 13–19). Data indicate that 150 minutes per week of moderate- to vigorous-intensity physical activity bring significantly lower risks.

There is a favourable and consistent effect of aerobic physical activity on achieving weight maintenance. Accumulation of energy expenditure due to physical activity is what is important to achieving energy balance. Accumulation of physical activity can be obtained in short multiple bouts of at least 10 minutes, or one long bout to meet physical activity expenditure goals for weight maintenance. The evidence is less consistent for resistance training, in part, because of the compensatory increase in lean mass, and the smaller volumes of exercise employed. There is substantial inter-individual variability with physical activity and weight maintenance; more than 150 minutes of moderate-intensity activity per week may be needed to maintain weight. Data from recent well-designed randomized control trials lasting up to 12 months indicate that aerobic physical activity performed to achieve a volume of at least 150 minutes per week is associated with approximately 1–3% weight loss, which is generally considered to represent weight maintenance. (11)

Physically active adults are likely to have less risk of a hip or vertebral fracture. Increases in exercise training can minimize the decrease in spine and hip bone mineral density. Increases in exercise training enhance skeletal muscle mass, strength, power, and intrinsic neuromuscular activation. (11, 13, 18, 19)

Weight-bearing endurance and resistance types of physical activity (i.e. exercise training) are effective in promoting increases in bone mass density (e.g. moderate- to vigorous-intensity activity performed 3–5 days per week, 30–60 minutes per session).

Regular practice of physical activity is linked to prevention of breast and colon cancer. Data indicate that moderate- to vigorous-intensity physical activity performed at least 30–60 minutes per day is needed to see significantly lower risks of these cancers.

Overall, strong evidence demonstrates that compared to less active adult men and women, individuals who are more active have lower rates of all-cause mortality, coronary heart disease, high blood pressure, stroke, diabetes, metabolic syndrome, colon cancer, breast cancer, and depression. Strong evidence also supports the conclusion that, compared to less active people, physically active adults and older adults exhibit a higher level of cardiorespiratory and muscular fitness, have a healthier body mass and composition, and a biomarker profile that is more favourable for preventing cardiovascular disease and type 2 diabetes and for enhancing bone health.

A detailed reference of the literature used by the guidelines group to develop these recommendations can be found in Appendix 2.



RECOMMENDATIONS

In adults aged 18–64, physical activity includes leisure time physical activity, transportation (e.g. walking or cycling), occupational (i.e. work), household chores, play, games, sports or planned exercise, in the context of daily, family, and community activities.

The guidelines group reviewed the above cited literature and recommended that in order to improve cardiorespiratory and muscular fitness, bone health, reduce the risk of NCDs and depression:

- 1. Adults aged 18–64 should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity activity.**
- 2. Aerobic activity should be performed in bouts of at least 10 minutes duration.**
- 3. For additional health benefits, adults should increase their moderate-intensity aerobic physical activity to 300 minutes per week, or engage in 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate- and vigorous-intensity activity.**
- 4. Muscle-strengthening activities should be done involving major muscle groups on 2 or more days a week.**

INTERPRETATION AND JUSTIFICATION

Conclusive scientific evidence, based on a wide range of well-conducted studies, shows that physically active people have higher levels of health-related fitness, a lower risk profile for developing a number of disabling medical conditions, and lower rates of various chronic noncommunicable diseases than do people who are inactive.

There are multiple ways of accumulating the total of 150 minutes per week. The concept of accumulation refers to meeting the goal of 150 minutes per week by performing activities in multiple shorter bouts of at least 10 minutes each, spread throughout the week then adding together the time spent during each of these bouts: e.g. 30 minutes of moderate-intensity activity 5 times per week.

Evidence of acute effects on biomedical markers points to benefits of undertaking regular physical activity throughout the week (such as 5 or more times per week). Moreover this has the potential to encourage integrating physical activity as part of daily lifestyle such as active travel through walking and cycling.

The recommendations listed above are applicable to the following health conditions: cardiorespiratory health (coronary heart disease, cardiovascular disease, stroke and hypertension); metabolic health (diabetes and obesity); bone health and osteoporosis; breast and colon cancer and depression.

The volume of physical activity associated with the prevention of different chronic NCDs varies. However, the evidence is currently insufficiently precise to warrant separate guidelines for each specific disease, but it is strong enough to cover all health outcomes selected.

Higher volumes of activity (i.e. greater than 150 minutes per week) are associated with additional health benefits. However the evidence is not available to identify additional or increased benefits for volumes greater than 300 minutes per week.

The costs of adopting these recommendations are minimal and essentially related to the translation into country settings, communication and dissemination. Implementation of comprehensive policies that will facilitate the achievement of the recommended levels of physical activity will require additional resource investment.

These recommendations are applicable in low- and middle-income countries. However national authorities need to adapt and translate them into culturally appropriate forms for country level, taking into consideration, among other factors, the need to identify and adapt to the physical activity domain which is most prevalent at the population level (e.g. leisure time, occupational or transportation physical activity).

Activity-related adverse events such as musculoskeletal injuries are common but are usually minor especially for moderate-intensity activities such as walking. Overall, the benefits of being physically active and implementing the above recommendations outweigh the harms. The inherent risk of adverse events can be significantly reduced by a progressive increase in the activity level, especially in inactive adults. Selecting low-risk activities and adopting prudent behaviour while doing any activity can minimize the frequency and severity of adverse events and maximize the benefits of regular physical activity. In order to reduce the risk of injuries, the use of protective equipment, such as helmets, should be encouraged.

It should be noted that, in populations that are already active the national physical activity guidelines should not promote a physical activity target that would encourage a reduction in current levels.



AGE GROUP: 65 YEARS OLD AND ABOVE



TARGET POPULATION

These guidelines are relevant to all healthy adults aged 65 years and above. They are also relevant to individuals in this age range with chronic NCDs. Individuals with specific health conditions, such as cardiovascular disease and diabetes, may need to take extra precautions and seek medical advice before striving to achieve the recommended levels of physical activity for older adults.

These recommendations are applicable for all older adults irrespective of gender, race, ethnicity or income level. However, the communication strategies, dissemination and messaging of the recommendations may differ in various population groups in order to be most effective.

The recommendations can be applied to older adults with disabilities however they may need to be adjusted for each individual, based on their exercise capacity and specific health risks or limitations.

NARRATIVE SUMMARY OF SCIENTIFIC EVIDENCE (11, 13, 20, 21)

The review of the literature relating cardio respiratory fitness, muscular strength, metabolic health and bone health to the rationale for relation and dose response patterns was based on an evaluation from the CDC literature review (2008) the evidence reviews from Warburton et al (2007 and 2009), the review by Bauman et al (2005) and the systematic reviews by Paterson et al (2007 and 2009). (11, 13, 20, 21)

There is strong scientific evidence that regular physical activity produces major and extensive health benefits in both adults aged 18–64 and in older adults aged 65 and above. In some cases the evidence of health benefits is strongest in older adults because the outcomes related to inactivity are more common in older adults. This results in an increased ability of observational studies to detect the protective effect of physical activity in this age group. Overall, conclusive evidence shows that both moderate-intensity and vigorous-intensity activity provide similar health benefits in both adult age groups. (11, 13, 20, 21)

The overall evidence for adults aged 65 years and above demonstrates that, compared to less active individuals, men and women who are more active have lower rates of all-cause mortality, coronary heart disease, high blood pressure, stroke, type 2 diabetes, colon cancer, breast cancer, a higher level of cardiorespiratory and muscular fitness, healthier body mass and composition, and a biomarker profile that is more favourable for the prevention of cardiovascular disease, type 2 diabetes and the enhancement of bone health. (11, 13, 20, 21)

These benefits are observed in adults in the older age range, with or without existing NCDs. Hence inactive adults of the 65 years and above age group, including those with NCDs, are likely to gain health benefits by increasing their level of physical activity. If they cannot increase activity to levels required to meet guidelines, they should be active to the level their abilities and health conditions allow. Older adults who currently do not meet the recommendations for physical activity should aim to increase physical activity gradually, starting with increasing duration and frequency of moderate-intensity activity before considering increasing the intensity to vigorous-intensity activity. In addition, strong evidence indicates that being physically active is associated with higher levels of functional health, a lower risk of falling, and better cognitive

function. There is observational evidence that mid-life and older adults who participate in regular physical activity have reduced risk of moderate and severe functional limitations and role limitations. In older adults with existing functional limitations, there is fairly consistent evidence that regular physical activity is safe and has a beneficial effect on functional ability. However, there is currently little or no experimental evidence in older adults with functional limitations that physical activity maintains role ability or prevents disability. The CDC literature Review (2008) and the systematic reviews by Paterson (2007) and Patterson and Warburton (2009) were used to develop the recommendation related to limited mobility due to health conditions. The dose-response pattern related to depression and cognitive decline were reviewed from the CDC Literature review (2008). (11, 20, 21)

In older adults with poor mobility, there is consistent evidence that regular physical activity is safe and reduces risk of falls by nearly 30%. For prevention of falls, most evidence supports a physical activity pattern of balance training and moderate-intensity muscle-strengthening activities three times per week. There is no evidence that planned physical activity reduces falls in adults and older adults who are not at risk of falls. Evidence specific for this age group related to the maintenance or improvement of balance for those at risk of falling was reviewed from the systematic reviews by Paterson (2007) and Patterson and Warburton (2009). (20, 21)

A more detailed reference of the literature used by the guidelines group to develop these recommendations can be found in Appendix 2.

RECOMMENDATIONS

In older adults of the 65 years and above age group, physical activity includes leisure time physical activity, transportation (e.g. walking or cycling), occupational (if the individual is still engaged in work), household chores, play, games, sports or planned exercise, in the context of daily, family and community activities.

The guidelines group reviewed the above cited literature and recommended that in order to improve cardiorespiratory and muscular fitness, bone and functional health, reduce the risk of NCDs, depression and cognitive decline:

- 1. Adults aged 65 years and above should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity activity.**
- 2. Aerobic activity should be performed in bouts of at least 10 minutes duration.**
- 3. For additional health benefits, adults aged 65 years and above should increase their moderate-intensity aerobic physical activity to 300 minutes per week, or engage in 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate-and vigorous-intensity activity.**
- 4. Adults of this age group, with poor mobility, should perform physical activity to enhance balance and prevent falls on 3 or more days per week.**
- 5. Muscle-strengthening activities should be done involving major muscle groups, on 2 or more days a week.**
- 6. When adults of this age group cannot do the recommended amounts of physical activity due to health conditions, they should be as physically active as their abilities and conditions allow.**



JUSTIFICATION AND INTERPRETATION

Despite the similarities between the recommendations for adults aged 18–65 and for adults aged 65 and above, separate recommendations should be adopted and implemented. Promoting and facilitating the regular practice of physical activity in older adults is especially important because this population group is very often the least physically active. Efforts to promote physical activity in older adults will generally place less emphasis on attaining high volumes of activity, or engaging in vigorous-intensity activity. However, the health status and abilities of older adults vary widely, and some older adults are capable of, and regularly perform, high volumes of moderate- and vigorous-intensity activity.

Conclusive scientific evidence based on a wide range of well-conducted studies shows that adults of the 65 years and above age group, who are physically active, have higher levels of cardiorespiratory fitness, a lower risk profile for developing a number of disabling medical conditions, and lower rates of various chronic noncommunicable diseases than do those who are inactive.

If an individual has a low exercise capacity (i.e. low physical fitness), the intensity and amount of activity needed to achieve many health-related and fitness benefits are less than for an individual who has a higher level of activity and fitness. Because the exercise capacity of adults tends to decrease as they age, older adults generally have lower exercise capacities than younger persons. They therefore need a physical activity plan that is of lower absolute intensity and amount (but similar in relative intensity and amount) than is appropriate for people of greater fitness, especially when they have led sedentary lifestyles and are starting out on an activity programme.

As with adults of the 18–65 age group, there are a number of ways older adults can accumulate the total of 150 minutes per week. The concept of accumulation refers to meeting the goal of 150 minutes per week by performing activities in multiple shorter bouts of at least 10 minutes each spread throughout the week then adding together the time spent during each of these bouts: e.g. 30 minutes of moderate-intensity activity 5 times per week.

It is worth noting that the recommended moderate- to vigorous-intensity activity is relative to the capacity of the individual to perform such activities.

Evidence of acute effects on biomedical markers points to benefits of undertaking regular physical activity throughout the week (such as 5 or more times per week). This also has the potential to encourage integrating physical activity as part of daily lifestyle such as active travel through walking and cycling.

The recommendations listed above are applicable to the following health conditions: cardio-respiratory health (coronary heart disease, cardiovascular disease, stroke and hypertension); metabolic health (diabetes and obesity); bone health and osteoporosis; breast and colon cancer and prevention of falls, depression and cognitive decline.

The volume of physical activity associated with the prevention of different chronic NCDs varies. Although the current evidence is insufficiently precise to warrant separate guidelines for each specific disease, it is sufficiently sound to cover all the health outcomes selected.

Higher levels of activity (i.e. greater than 150 minutes per week) are associated with additional health benefits. However the evidence suggests there is decreasing marginal benefit from engaging in physical activity above volumes equivalent to 300 minutes per week of moderate-intensity activity, and an increased risk of injuries.

The costs of endorsing these recommendations are minimal and essentially related to the translation into country settings, communication and dissemination. Implementation of comprehensive policies that will facilitate the achievement of the recommended levels of physical activity will require additional resource investment.

These recommendations are applicable in low- and middle-income countries. However, national authorities need to adapt and translate them into culturally appropriate forms for country level taking into consideration, among other factors, the physical activity domain which is more prevalent at population level (i.e. leisure time, occupational or transportation physical activity).

Overall, the benefits of being physically active and implementing the above recommendations outweigh the harms. Activity-related adverse events such as musculoskeletal injuries are common but are usually mild, especially for moderate-intensity activities such as walking. The inherent risk of adverse events can be significantly reduced by a progressive increase in the activity level, especially in sedentary older adults. A series of small increments in physical activity, each followed by a period of adaptation, is associated with lower rates of musculoskeletal injuries than is an abrupt increase to the same final level. For sudden cardiac adverse events, intensity of activity, rather than frequency or duration appears to have more adverse effect. The selection of low-risk activities, and prudent behaviour while performing any activity, can minimize the frequency and severity of adverse events and maximize the benefits of regular physical activity.

It should be noted that in populations that are already active, the national physical activity guidelines should not promote a physical activity target that would encourage a reduction in their current levels.

4.5 FUTURE REVIEW OF RECOMMENDATIONS AND RESEARCH GAPS

Results expected in the following few years regarding objectively measured physical activity levels, and the scientific knowledge being accumulated in areas such as sedentary behaviours, will necessitate a review of these recommendations by the year 2015.

The following are research areas that require further investigation:

- 1) Sedentary behaviour contributing to disease risk profile.
- 2) Health-enhancing physical activity in children under 5 years old.
- 3) Health-enhancing physical activity in pregnant women.
- 4) Physical activity and disabilities.
- 5) Weight loss or maintenance of weight loss.
- 6) Physical activity doses for the clinical treatment of people with an NCD (e.g. cardiovascular disease, diabetes, cancer, obesity, mental health conditions, etc.).



5

HOW TO USE THE RECOMMENDED LEVELS OF PHYSICAL ACTIVITY FOR HEALTH



5.1 INTRODUCTION

This section includes general principles for using the recommended levels of physical activity for health in the development of national policies, and highlights issues to be considered by policy-makers in the process of adaptation to the national context.

The *Global Recommendations on Physical Activity for Health* outlined in this document can play an important role in guiding the overall efforts on promotion of health-enhancing physical activity. Additionally these can:

- support the development of physical activity policy;
- be used by all relevant stakeholders to communicate valid and consistent messages on the frequency, duration, intensity, type and total amount of physical activity for health;
- be used by health professionals to inform patients;
- have the potential to become a tool to link communication between scientists, health professionals, journalists, interest groups and the general public and represent the translation of research findings into actionable, achievable and measurable messages for practitioners, policy-makers and communities;
- be used as benchmarks for public health monitoring and surveillance purposes.

5.2 NATIONAL ADAPTATION OF THE GLOBAL RECOMMENDATIONS

The Global Recommendations should be understood as an evidence-based starting point for policy-makers looking to promote physical activity at national level.

Policy-makers at national level are encouraged to adopt the recommended levels of physical activity for health proposed in this document.

Policy-makers are encouraged to incorporate the global recommended levels of physical activity for health to national policies, taking into consideration the most adequate and feasible options according to their needs, characteristics, physical activity domain and national resources while aiming to be participatory and socially inclusive, particularly of the most vulnerable groups.

In addition, the adaptation and translation of the recommended levels of physical activity at national level must take into consideration the cultural background, gender issues, ethnic minorities and burden of disease relevant to the country. Listed below are additional issues to be considered by policy-makers when using the global recommended levels of physical activity for health in national or local interventions:

- Social norms.
- Religious values.
- Security situation at national and/or local levels.
- Availability of safe spaces for the practice of physical activity.
- Geographical settings, seasons and climate.
- Gender issues.
- Involvement of all concerned sectors and actors.
- Role of municipalities and local leadership.
- Access and attendance to schools and worksite, especially with regard to girls and women.
- Existing transport infrastructures, sports and recreational facilities and urban design.
- Patterns of participation in all domains of physical activity (leisure, transportation and occupational).

5.2.1 LOW-AND-MIDDLE INCOME COUNTRIES

In many low- and middle-income countries, the levels of participation in leisure time physical activity may be limited, and moderate to vigorous physical activity may be performed in the context of transport and/or occupational and/or domestic activities. These characteristics and patterns of physical activity must be taken into consideration for a more tailored and targeted implementation of interventions aiming at promoting the global recommended levels of physical activity for health.

In countries with high levels of occupational and transportation physical activity, policy-makers need to acknowledge that, although these high levels of activity may not be the result of efforts to improve health, such levels of activity provide major health benefits for the population. Caution is therefore needed when implementing policies and infrastructure changes which may lead to a reduction in the levels of physical activity in any domain.

For those communities who currently do not achieve the global recommendations of physical activity for health, science supports health benefits for both moderate- and vigorous-intensity activity. However the net health benefit (benefits versus risks) in community-based programmes is likely to be higher if the main focus is on moderate-intensity activity. Moderate-intensity activity is more relevant to the public health goals of policy implementation than vigorous-intensity activity because of the lower risk of orthopaedic injuries and other medical complications potentially acquired during moderate-intensity activity. If the focus of policy implementation is in promoting vigorous-intensity activity, issues related to potential risks, especially for older adults and populations with various morbidities, need to be taken into consideration. For both levels of intensity, the use of appropriate protective equipment should always be encouraged.

5.3 SUPPORTIVE POLICIES IN PROMOTING PHYSICAL ACTIVITY

National guidelines or recommendations on physical activity for the general population are needed to inform the population on the frequency, duration, intensity, types and total amount of physical activity necessary for health. However, increasing levels of physical activity in the population demands a population-based, multisectoral, multidisciplinary, and culturally relevant approach. National policies and plans on physical activity should comprise multiple strategies aimed at supporting the individual and creating supportive environments for physical activity to take place. (3,5)

Current evidence shows that environmental policies that impact on the mode of transport people use or that increase public space for recreational activities have the potential to increase physical activity levels in the population and consequently provide significant health benefits. This is of particular relevance to LMIC. (3, 22)

Possible physical activity promoting interventions include:

- reviewing urban and town planning and environmental policies at national and local level to ensure that walking, cycling and other forms of physical activity are accessible and safe;
- providing local play facilities for children (e.g. building walking trails);
- facilitating active transport to work (e.g. cycling and walking) and other physical activity strategies for the working population;
- ensuring that school policies support the provision of opportunities and programmes for physical activity;



- providing schools with safe and appropriate spaces and facilities so that students can spend their time actively;
- providing advice or counsel in primary care; and
- creating social networks that encourage physical activity. (3, 22, 23)

5.4 STRATEGIES FOR COMMUNICATING THE GLOBAL RECOMMENDATIONS AT NATIONAL LEVEL

Adopting the global recommendations and integrating them to national policies, programmes and interventions is an important initial step in communicating physical activity levels to communities and the public. However, in order to encourage acceptance, uptake and adherence to physical activity promotion activities by the target populations, nationally adapted messages need to be developed and widely disseminated to all relevant stakeholders, professional groups and to the general community.

Effective dissemination of the recommended levels of physical activity for health requires strategic planning, strong collaborations between various groups and resources for supporting communication and dissemination efforts (3, 24).

Countries with differing levels of physical activity will likely need to communicate and disseminate different strategies and messages to their communities and to the public. Consequently, when taking into consideration national and subnational cultural and environmental factors, it is advisable to develop a comprehensive, communication strategy for effective dissemination of the global recommended levels of physical activity for health, which addresses all possible variance.

It is similarly advisable to adopt a communication strategy that includes simple, understandable and adaptable messages which are culturally sensitive. It should be highlighted, however, that while the messages used may vary from country to country, or may even differ within the same country, policy-makers and communication experts should aim to retain the core recommended levels of physical activity for health outlined in the previous section.

Appendix 3 gives examples of messages consistent with the recommended levels of physical activity for health which have been used to promote physical activity in various countries, and can be used as guidance for LMIC when developing their national communication strategies.

5.5 MONITORING AND EVALUATION

Evaluation and ongoing monitoring of the process and outcomes of actions for the promotion of physical activity is necessary in order to:

- examine programme success and to identify target areas for future plans of action;
- ensure the policy, plan or programme is being implemented as intended;
- contribute to ongoing learning and continuous improvement of the actions implemented;
- assist policy-makers in decision-making regarding existing policies, plans and programmes, including the development of new ones; and
- facilitate transparency and accountability. (25)

(Additional resources for monitoring and evaluation processes are included in the following section.)

6

RESOURCES



INTRODUCTION

The development and dissemination of national physical activity guidelines should be seen as one element of a broader policy and planning process to promote physical activity. To achieve effective change in awareness and set the agenda for behaviour and environmental change, it is necessary to integrate the guidelines into a national physical activity policy and plan of action.

In some countries it might also be necessary to link physical activity guidelines to other public health and prevention issues. For example, in the health sector, guidelines might be linked to the prevention and control of noncommunicable diseases, or to specific health issues such as diabetes or obesity. In the sport sector, physical activity guidelines might be linked to community participation in organized and non-organized sport and leisure pursuits. Greater gains can be achieved by positioning physical activity guidelines as part of a comprehensive planning of noncommunicable diseases prevention and control or other public health issues, such as framing the guidelines as part of objectives setting, intervention selection and implementation, and monitoring and surveillance.

Listed below are some of the key resources available to WHO to support Member States in the development, implementation, monitoring and evaluation of policies related to physical activity promotion:

POLICY DEVELOPMENT AND IMPLEMENTATION:

- A guide for population-based approaches to increasing levels of physical activity: implementation of the Global Strategy on Diet, Physical Activity and Health (3):
<http://www.who.int/dietphysicalactivity/PA-promotionguide-2007.pdf>.
- Report of joint WHO/World Economic Forum event on prevention of noncommunicable diseases in the workplace (26):
<http://www.who.int/dietphysicalactivity/workplace>.
- A school policy framework focusing on diet and physical activity (23):
<http://www.who.int/dietphysicalactivity/schools>.
- Interventions on Diet and Physical Activity: What Works. Implementation of the Global Strategy on Diet, Physical Activity and Health (22):
<http://www.who.int/dietphysicalactivity/whatworks>.
- Pacific Physical Activity Guidelines for Adults: Framework for Accelerating the Communication of Physical Activity Guidelines (24):
http://www.wpro.who.int/NR/rdonlyres/6BF5EE82-8509-4B2F-8388-2CE9DBCCA0F8/0/PAG_layout2_22122008.pdf.

SURVEILLANCE, MONITORING AND EVALUATION:

- The WHO STEPwise approach to surveillance (STEPS):
<http://www.who.int/chp/steps/en>.
- The Global school-based student health survey (GSHS):
http://www.who.int/school_youth_health/assessment/gshs/en.
- The WHO Global InfoBase: WHO global comparable estimates:
<http://infobase.who.int>.
- The Global Questionnaire on Physical Activity for Health (GPAQ):
<http://www.who.int/chp/steps/GPAQ>.
- A framework to monitor and evaluate implementation: Global Strategy on Diet, Physical Activity and Health (25):
<http://www.who.int/dietphysicalactivity/DPASindicators>.

7

APPENDICES

DETAILED DESCRIPTION OF THE METHODOLOGY USED FOR DEVELOPING THE GLOBAL RECOMMENDATIONS ON PHYSICAL ACTIVITY FOR HEALTH

The following steps summarize the actions by the WHO Secretariat for the development of the *Global Recommendations on Physical Activity for Health*:

First phase: Scope and target audience

1) A global expert meeting was arranged in January 2008 in Mexico to examine the scientific evidence available on physical activity and health and to assess the need to develop global recommendations on physical activity for health. The experts who participated in this meeting concluded that there was the need and enough evidence for WHO to develop global recommendations on physical activity for health. Moreover, it was highlighted that the comprehensive review being prepared by the CDC, included in *Physical Activity Guidelines Advisory Committee Report, 2008* (11), should be part of the bulk of scientific evidence considered for the development of the *Global Recommendations on Physical Activity for Health*. In addition, the scope, content and target audience of the global recommendations were defined by the participating experts by discussion and consensus.

Second phase: Evidence collection and analysis

1) Evidence collection: A vast and strong body of evidence has been used for the development of the first draft. This includes:

- the 2008 CDC literature Review presented in the report to the USA Secretary of Health and Human Services titled "Physical Activity Guidelines Advisory Committee Report" (11);
- Bauman et al 2005: the 2005 systematic review of the evidence on "The Health Benefits of Physical Activity in Developing Countries" which has been carried out by the Centre for Physical Activity and Health, University of Sydney) (13);
- Evidence reviews conducted as part of the process to update the Canadian physical activity guidelines (9, 10, 18- 21);
- a review of the relevant literature in Chinese and Russian using the same search framework that had been used by the 2008 CDC literature review.

Table 1. Overview of evidence documents used

| Source of evidence used by WHO secretariat and guideline group | Rational for selecting this review | Considerations by guideline group |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The 2008 CDC Literature Review presented in the report to the USA Secretary of Health and Human Services titled "Physical Activity Guidelines Advisory Committee Report" (11) | This publication was a result of the search of the Medline literature - covering the period of January 1, 1995 -November 2007 - 14,472 abstracts were triaged, and of these, 1,598 papers were reviewed. The review included: cohort studies, case control studies, randomized control trials, non randomized control trial, meta analysis, observational studies, prospective studies and cross sectional studies. All cause mortality, cardiorespiratory health, metabolic health, musculo-skeletal health, functional health, cancer, mental health and adverse events. The populations studied were children and youth, adults and older adults. This is an extensive, global, high quality and up to date review which covers the outcomes of interest. | Study design, limitations of the studies, sample size, statistical power, precision of results, measurement methods, follow-up, adherence were considered to conclude that this review provided strong evidence for the development of the global recommendations. |
| The 2005 systematic review of the evidence on "The Health Benefits of Physical Activity in Developing Countries" - Centre for Physical Activity and Health, University of Sydney (13) | This is a global review, focusing on grey and peer reviewed literature from low and middle income countries. To identify relevant published epidemiological studies on physical activity and health in developing countries multiple electronic databases were searched. These included NIH Pub Med, Medline, Psycinfo and two evidence based directories, The Cochrane Library and DARE. Additional papers were identified via hand searching. The search strategy was restricted to English language papers published from January 1980 – March 2007. 47 studies conducted in low and middle income countries, with different designs were included in this review: cross sectional surveys (descriptive and analytic), cohort studies, randomized control trials and case control studies. They covered all cause mortality, cardiovascular disease diabetes, cancers, injuries and bone health, mental health and associated risk factors. | The strength of dose-response relationships is assessed based on the volume of data available and the level of consistency between the various study findings. This was considered to provide strong evidence for the development of the global recommendations. |

| | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>2007 evidence reviews conducted as part of the process to update the Canadian physical activity guidelines (9, 18, 20)</p> | <p>These reviews of the literature provide an analysis of the epidemiology related to physical activity for health, and the strength of the relationship between physical activity and specific health outcomes is evaluated, with particular emphasis on minimal and optimal physical activity requirements. Meta analysis, systematic reviews, epidemiological studies and randomized control trials were included in this review.</p> <p>Cardiorespiratory health, hypertension, breast and colon cancer, diabetes, adiposity, mental health osteo-musculoskeletal health, osteoporosis, injuries and asthma were health outcomes included in these reviews. These are comprehensive and high quality reviews which cover the outcomes of interest and the relevant age groups.</p> | <p>The strength of dose-response relationships is assessed based on the volume of data available and the level of consistency between the various study findings. This was considered to provide strong complementary evidence for the development of the global recommendations.</p> |
| <p>2009 Evidence reviews conducted as part of the process to update the Canadian physical activity guidelines (10, 19, 21)</p> | <p>For all 3 papers, the literature was obtained through searching electronic databases. All articles included in these reviews were reviewed to complete standardized data extraction tables, and assess study quality. An established system of assessing the level and grade of evidence for the recommendations was employed by the research groups. Various study types were included in this review: prospective cohort studies randomized control trials, and non-RCT study types 86 studies were included in the review focusing on children and youth. The volume, intensity, and type of physical activity were considered.</p> <p>A total of 254 articles met the eligibility criteria for the review focusing on adults. 100 studies were included in the review focusing on older adults.</p> | <p>Study design, limitations of the studies, sample size, statistical power, precision of results, measurement methods, follow-up, adherence were considered to conclude that the three age specific reviews provided strong evidence for the development of the global recommendations.</p> |
| <p>The systematic research of the literature to search for evidence published in Chinese and Russian (the same inclusion and exclusion criteria and the same time frame of research used in the CDC review were used to conduct this additional search).</p> | <p>This ensured that all studies relevant to the outcomes of interest and published in languages other than English will be included in the evidence, strengthening its global coverage.</p> <p>The additional evidence from other languages was assessed using the same criteria that have been used for the CDC systematic review.</p> <p>10 articles in the Russian language and 164 articles in Chinese were retrieved. Three articles in Russian and 71 in Chinese were considered relevant to the outcomes.</p> | <p>The evidence found was consistent with the other literature reviews and added no extra knowledge for the guideline group to consider.</p> |

2) Summarizing the evidence collected

The WHO Secretariat reviewed and analysed all the sources of evidence listed above. Based on this body of evidence, narrative descriptions summarizing the evidence available for the relevant health outcomes were prepared.

These narrative descriptions of the evidence included information on: the number and type of studies included in each review, magnitude of effect, the quality of the evidence, characteristics of the physical activity most likely to produce the outcome and the evidence of a dose response for the age group and health outcomes selected.

Third phase: Preparation of the draft for the *Global Recommendations on Physical Activity for Health*

1) After all the evidence had been collected and analysed, the WHO Secretariat led by the Surveillance and Population-based Prevention Unit at WHO-HQ in collaboration with the WHO Regional Offices:

- established the process for developing the Global Recommendations on Physical Activity for Health and cleared it with the WHO Guideline Review Committee;
- established a guideline group (see Appendix 4 for members), which took into consideration: global representation, gender balance and area of expertise both in the subject matter as well as in policy development and implementation;
- prepared a narrative summary of the evidence relevant to the health outcomes previously selected; and
- developed a first draft of the *Global Recommendations on Physical Activity for Health*.

2) The draft of the *Global Recommendations on Physical Activity for Health* was used in a first round of electronic consultations with the guideline group through the online "community

of practice” website. To collect the comments from all the guideline group members, the WHO Secretariat prepared a template with specific questions, The template requested comments on:

- the overall quality of the evidence for major health outcomes and to evaluate the issues of dose response for these outcomes;
- health conditions to which the recommendations are applicable;
- the content and formulation of the recommendations;
- generalizability and applicability of the recommendations in low and middle income countries;
- benefits and harms; and
- costs of developing and endorsing the physical activity recommendations.

All comments made by the guideline group members were compiled by the WHO Secretariat and presented at the meeting of the guideline group.

3) The draft of the *Global Recommendations on Physical Activity for Health* was used in a first round of electronic consultations with the Guideline group. A standard reporting form was used to collect the comments from all the group members in order to focus the discussions of the experts on:

- the scientific evidence used;
- the health conditions to which the recommendations are applicable;
- the content and formulation of the recommendations;
- the applicability of the recommendations in low- and middle-income countries;
- the potential benefits and harms; and
- the costs of developing and endorsing the physical activity recommendations.

Fourth phase: Meeting of the guideline group

The guideline group met on the 23rd Oct 2009 with the aim of:

- reviewing face-to-face the draft *Global Recommendations on Physical Activity for Health* proposed by the Secretariat;
- discussing the comments raised by the different guideline group members during the electronic consultation; and
- finalizing the recommendations.

At the meeting, the Secretariat presented the below information:

- what is expected from the guideline group members during the meeting;
- the expected outcomes for the meeting;
- an overview of the process used for the development of the *Global Recommendations on Physical Activity for Health*;
- a narrative summary of the evidence used to prepared the first draft of the Global Recommendations;
- a summary of the comments received from all guideline group members in the electronic consultation phase.

The meeting was conducted in the format of plenary session. Three main sessions were organized according to the age groups being discussed: children, adults and older adults. At the beginning of each age specific session, the summary of the age specific evidence, comments submitted by the members of the guideline group were presented.

Finalizing the recommendations:

For finalizing each recommendation presented in “Chapter 4”, the following steps were followed:

1) The draft recommendations were presented by the WHO Secretariat, with reference to the relevant evidence summary.

2) The evidence was reviewed and discussed by the group. To determine the quality of the evidence, the guideline group considered the types of studies that addressed each specific question, the general quality of these studies (e.g., design, sample size, statistical power, measurement methods, follow-up, adherence) for each major outcome.

3) The draft recommendations were reviewed by the guideline group considering:

- wording formulation considering concepts of: duration/volume, intensity, type, and frequency for physical activity
- health conditions to which each recommendation are applicable
- the balance of evidence for benefits and harms
- costs
- applicability in low and middle income countries
- values, preferences.

4) After the discussion, the draft recommendation was modified (if necessary) and a final recommendation was presented to the guideline group.

The same process was repeated for all recommendations presented in chapter 4.

The finalized recommendations were considered to be applicable in low-middle income countries after the appropriate adaptation and tailoring for implementation by national authorities. Details on the national adaptation of the *Global Recommendations on Physical Activity for Health* are provided in Chapter 5.

Fifth phase: Finalization and dissemination

1) Peer review of the recommendations and consultation with the WHO Regional Offices and relevant departments within WHO-Headquarters (Child and Adolescent Health, Ageing, Health Promotion and Violence and Injury Prevention).

2) Finalization of the recommendations and approval by the WHO Guideline Review Committee.

3) Translation, printing and dissemination.

Sixth phase: Implementation

The *Global Recommendations on Physical Activity for Health* will be integrated in the activities planned for the implementation of the 2008-2013 Action Plan for the Prevention and Control of NCD, and will be integrated as one of the key tools in the "DPAS Implementation Toolbox", which is available on the WHO website. Additionally, these recommendations will be a key component of the regional and sub-regional training and capacity building workshops being held by EURO, EMRO, WPRO and AFRO for 2010; and AMRO/PAHO and SEARO for 2011.

Evidence used for the age group: 5 - 17 years old

| | | | |
|------------------------------------------------------------|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| For enhanced cardio-respiratory health¹: | Supporting evidence in 2008 CDC Literature Review (11) (relevant page n°) | 2005, "The Health Benefits of Physical Activity in Developing Countries" (13) | Evidence reviews conducted as part of the process to update the Canadian physical activity guidelines (9,10) |
| Frequency & duration | Part E: E-1 - E-3 E-17 - E-19 Part G9: G9-1-G9-14 G9-20 - G9-21 | Not applicable as the review only included studies with adults | Janssen 2007 Janssen, Leblanc 2009 |
| Intensity | Part E: E-1 - E-3 E-17 - E-19 Part G9: G9-1-G9-5 G9-9 - G9-14 G9-20 - G9-21 | Not applicable as the review only included studies with adults | Janssen 2007 Janssen, Leblanc 2009 |
| Intensity & frequency | Part E: E-1 - E-3 E-17 - E-19 Part G9: G9-1-G9-5 G9-9 - G9-14 G9-20 - G9-21 | Not applicable as the review only included studies with adults | Janssen 2007 Janssen, Leblanc 2009 |
| Type & frequency | Part E: E-1 - E-3 E-17 - E-19 Part G9: G9-1-G9-5 G9-9 - G9-14 G9-20 - G9-21 | Not applicable as the review only included studies with adults | Janssen 2007 Janssen, Leblanc 2009 |
| For enhanced metabolic health²: | Supporting evidence in 2008 CDC Literature Review (11) (relevant page n°) | 2005, "The Health Benefits of Physical Activity in Developing Countries" (13) | Evidence reviews conducted as part of the process to update the Canadian physical activity guidelines (9,10) |
| Frequency & duration | Part E: E-1 - E-3 E-17 - E-19 Part G9: G9-1-G9-10 G9-20 - G9-21 | Not applicable as the review only included studies with adults | Janssen 2007 Janssen, Leblanc 2009 |
| Intensity | Part E: E-1 - E-3 E-17 - E-19 Part G9: G9-1- G9-10 G9-20 - G9-21 | Not applicable as the review only included studies with adults | Janssen 2007 Janssen, Leblanc 2009 |
| Intensity & frequency | Part E: E-1 - E-3 E-17 - E-19 Part G9: G9-1- G9-10 G9-20 - G9-21 | Not applicable as the review only included studies with adults | Janssen 2007 Janssen, Leblanc 2009 |
| Type & frequency | Part E: E-1 - E-3 E-17 - E-19 Part G9: G9-1- G9-10 G9-20 - G9-21 | Not applicable as the review only included studies with adults | Janssen 2007 Janssen, Leblanc 2009 |

¹Cardiorespiratory health refers to risk reduction of coronary heart disease, cardiovascular disease, stroke and hypertension²Metabolic Health refers to risk reduction of diabetes and obesity

| | | | |
|----------------------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| For enhanced musculo-skeletal health³: | Supporting evidence in 2008 CDC Literature Review (11) (relevant page n°) | 2005, "The Health Benefits of Physical Activity in Developing Countries" (13) | Evidence reviews conducted as part of the process to update the Canadian physical activity guidelines (9,10) |
| Frequency & duration | Part E: E-1 - E-3 E-17 - E-19 Part G9: G9-1-G9-10 G9-20 - G9-21 | Not applicable as the review only included studies with adults | Janssen 2007 Janssen, Leblanc 2009 |
| Intensity | Part E: E-1 - E-3 E-17 - E-19 Part G9: G9-1- G9-10 G9-20 - G9-21 | Not applicable as the review only included studies with adults | Janssen 2007 Janssen, Leblanc 2009 |
| Intensity & frequency | Part E: E-1 - E-3 E-17 - E-19 Part G9: G9-1- G9-10 G9-20 - G9-21 | Not applicable as the review only included studies with adults | Janssen 2007 Janssen, Leblanc 2009 |
| Type & frequency | Part E: E-1 - E-3 E-17 - E-19 Part G9: G9-1- G9-10 G9-20 - G9-21 | Not applicable as the review only included studies with adults | Janssen 2007 Janssen, Leblanc 2009 |

Evidence used for the age group: 18 - 64 years old

| | | | |
|------------------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| For enhanced cardio-respiratory health⁴: | Supporting evidence in 2008 CDC Literature Review (11) (relevant page n°) | 2005, "The Health Benefits of Physical Activity in Developing Countries" (13) | Evidence reviews conducted as part of the process to update the Canadian physical activity guidelines (18,19) |
| Frequency, duration and Intensity | Part E: E-1 - E-3 E-5 - E-6 Part G2: G2-1- G9-40 | Section 4.1.2: page 23 Section 4.1.7: page 29 Section 4.2.3: page 34-36 Section 4.2.6: page 38 Section 5: page 41-43 | Warburton et al 2007 Warburton et al 2009 |
| Type & frequency | Part E: E-1 - E-3 E-5 - E-6 Part G2: G2-1- G9-40 | Section 4.1.2: page 23 Section 4.1.7: page 29 Section 4.2.3: page 34-36 Section 4.2.6: page 38 Section 5: page 41-43 | Warburton et al 2007 Warburton et al 2009 |

| | | | |
|---------------------------------------------------|--------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| For enhanced metabolic health⁵: | Supporting evidence in 2008 CDC Literature Review (11) (relevant page n°) | 2005, "The Health Benefits of Physical Activity in Developing Countries" (13) | Evidence reviews conducted as part of the process to update the Canadian physical activity guidelines (18,19) |
| Frequency, duration and Intensity | Part E: E-1 - E-3 E-6 - E-10 Part G3: G3-9- G3-29 Part G4: G4-1 - G4-8 G4-10 - G4-20 | Section 4.1.3: page 24 Section 4.1.7: page 29 Section 4.2.3: page 30-33 Section 4.2.6: pages 39, 40 Section 5: page 41-43 | Warburton et al 2007 (20-55 years old) Warburton et al 2009 |
| Type & frequency | Part E: E-1 - E-3 E-6 - E-10 Part G3: G3-9- G3-29 Part G4: G4-1 - G4-8 G4-10 - G4-20 | Section 4.1.3: page 24 Section 4.1.7: page 29 Section 4.2.3: page 30-33 Section 4.2.6: pages 39, 40 Section 5: page 41-43 | Warburton et al 2007 (20-55 years old) Warburton et al 2009 |

³For this age group musculo-skeletal health refers to improved bone health

⁴Cardiorespiratory health refers to risk reduction of coronary heart disease, cardiovascular disease, stroke and hypertension

⁵Metabolic Health refers to risk reduction of diabetes and obesity



| | | | |
|----------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| For enhanced musculo-skeletal health⁶: | Supporting evidence in 2008 CDC Literature Review (11) (relevant page n°) | 2005, "The Health Benefits of Physical Activity in Developing Countries" (13) | Evidence reviews conducted as part of the process to update the Canadian physical activity guidelines (18,19) |
| Frequency, duration and Intensity | Part E: E-1 - E-3 E-11 - E-13 Part G5: G5-1 - G5-17 Part G5: G5-31 - G5-38 | Section 4.1.5: pages 27, 28 Section 4.1.7: page 29 Section 4.2.3: page 36-38 Section 5: page 41-43 | Warburton et al 2007 (20-55 years old) Warburton et al 2009 |
| Type & frequency | Part E: E-1 - E-3 E-11 - E-13 Part G5: G5-1 - G5-17 Part G5: G5-31 - G5-38 | Section 4.1.5: pages 27, 28 Section 4.1.7: page 29 Section 4.2.3: page 36-38 Section 5: page 41-43 | Warburton et al 2007 (20-55 years old) Warburton et al 2009 |

| | | | |
|-------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| For cancer prevention⁷: | Supporting evidence in 2008 CDC Literature Review (11) (relevant page n°) | 2005, "The Health Benefits of Physical Activity in Developing Countries" (13) | Evidence reviews conducted as part of the process to update the Canadian physical activity guidelines (18,19) |
| Frequency, duration and Intensity | Part E: E-1 - E-3 E-15 - E-16 Part G7: G7-1 - G7-22 | Section 4.1.4: pages 25, 26 Section 5: page 41-43 | Warburton et al 2007 (20-55 years old) Warburton et al 2009 |
| Type & frequency | Part E: E-1 - E-3 E-15 - E-16 Part G7: G7-1 - G7-22 | Section 4.1.4: pages 25, 26 Section 5: page 41-43 | Warburton et al 2007 (20-55 years old) Warburton et al 2009 |

| | | | |
|------------------------------------------------|---------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| For prevention of depression: | Supporting evidence in 2008 CDC Literature Review (11) (relevant page n°) | 2005, "The Health Benefits of Physical Activity in Developing Countries" ⁸ (13) | Evidence reviews conducted as part of the process to update the Canadian physical activity guidelines ⁹ (18,19) |
| Frequency, type, duration and Intensity | Part E: E-16 - E-17 Part G8: G8-1 - G8-12 | See footnote 9 | See footnote 10 |

Evidence used for the age group: 65 + years old

For the following outcomes: cardiorespiratory health, metabolic health, musculo-skeletal health, cancer prevention¹⁰ and depression, the supporting evidence to older adults are the same as stated in the 18-64 years old group.

| | | | |
|-----------------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| For enhanced functional health¹¹: | Supporting evidence in 2008 CDC Literature Review (11) (relevant page n°) | 2005, "The Health Benefits of Physical Activity in Developing Countries" (13) | Evidence reviews conducted as part of the process to update the Canadian physical activity guidelines (20,21) |
| Frequency, duration and Intensity | Part E: E-1 - E-3 E-13 - E-15 Part G6: G6-1 - G6-22 | Section 4.1.5: pages 27, 28 Section 4.1.7: page 29 Section 4.2.3: page 36-38 Section 5: page 41-43 | Paterson 2007 Paterson, Warburton D 2009 |
| Type & frequency | Part E: E-1 - E-3 E-13 - E-15 Part G6: G6-1 - G6-22 | Section 4.1.5: pages 27, 28 Section 4.1.7: page 29 Section 4.2.3: page 36-38 Section 5: page 41-43 | Paterson 2007 Paterson, Warburton D 2009 |

⁶For this age group musculo-skeletal health refers to improved bone health and risk reduction of osteoporosis

⁷Cancer prevention refers to reduction of risk of breast and colon cancer

⁸Section 4.1.6: page 28 states that NO studies examining the relationship between mental health and physical activity in adults living in developing countries were identified

⁹Not applicable as the review did not include any aspect of mental health

¹⁰Cardiorespiratory health refers to risk reduction of coronary heart disease, cardiovascular disease, stroke and hypertension. Metabolic Health refers to risk reduction of diabetes and obesity. Musculo-skeletal health refers to improved bone health and risk reduction of osteoporosis. Cancer refers to reduction of risk of breast and colon cancer.

¹¹Functional Health refers to prevention of falls

Evidence specific for this age group related to maintenance or improvement of balance for those at risk of falling was also found in Paterson 2007 and Paterson, Warburton D 2009.

| | | | |
|------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Limited Ability due to health conditions | Supporting evidence in 2008 CDC literature Review (11) (relevant page n°) | 2005, "The Health Benefits of Physical Activity in Developing Countries" (13) | Evidence reviews conducted as part of the process to update the Canadian physical activity guidelines (20,21) |
| | Part E: E-1 - E-3 E-13 - E-15 Part G6: G6-1 - G6-22 | Not applicable as review didn't focused specifically on older adults | Paterson 2007 Paterson, Warburton D 2009 |

APPENDIX 3

EXAMPLES OF MESSAGES USED TO PROMOTE PHYSICAL ACTIVITY AT NATIONAL LEVEL AND CONSISTENT WITH THE GLOBAL RECOMMENDATIONS

| Age group: 5–17 years | | |
|--------------------------------------------------------------------------------------|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Country/Region | Target population | Messages used |
| Australia Australia's Physical Activity Recommendations for 5–12 year olds (27). | 5–12 years of age | Ideally, your child shouldn't spend more than two hours a day doing these things, particularly at times when they could be enjoying more active pursuits. If your child is just starting to get active, begin with moderate-intensity activity - say 30 minutes a day – and steadily increase. More vigorous activities will make kids "huff and puff" and include organized sports such as football and netball, as well as activities such as ballet, running and swimming laps. Children typically accumulate activity in intermittent bursts ranging from a few seconds to several minutes, so any sort of active play will usually include some vigorous activity. Most importantly, kids need the opportunity to participate in a variety of activities that are fun and suit their interests, skills and abilities. Variety will also offer your child a range of health benefits, experiences and challenges. |
| Australia Australia's Physical Activity Recommendations for 12–18 year olds (28). | 12–18 years of age | <ul style="list-style-type: none"> Choose a range of activities you like or think you might like to try. Be active with your friends. You are more likely to keep active if it's fun and you have people to enjoy it with. Walk more: to school, to visit friends, to shops, or other places in your neighbourhood. Try to limit time spent watching TV, videos or DVDs, surfing the net or playing computer games, especially during the day and on weekends. Take your dog or a neighbour's dog for a walk. Be active with family members – in the yard and on family outings. Encourage and support younger brothers and sisters to be active. Try a new sport or go back to one you have played before. Take a class to learn a new skill such as yoga, kick boxing, dancing or diving. Check out the activities at your local recreation centre, clubs or youth centre. Put on some music and dance. |
| Canada Canada's Physical Activity Guide for Children, 2002 (29). | Children 6–9 years of age | <ul style="list-style-type: none"> Physical activity is fun: At home – At school – At play – Inside or Outside – On the way to and from school – With family and friends. Making physical activity a part of the day is fun and healthy. Increase time currently spent on physical activity by 30 minutes per day, and progress to 90 minutes more per day. Physical activity can be accumulated in periods of 5–10 minutes. The 90 minute increase in physical activity should include 60 minutes of moderate activity and 30 minutes of vigorous activity. Combine endurance, flexibility, and strength activities to achieve the best results. Reduce screen time, starting with 30 minutes less daily and progressing to 90 minutes less daily. |



Age group: 18–64 years old

| Country/Region | Target population | Messages used |
|--------------------------------------------------------------------------------------------------------------------------------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Australia National Physical Activity Guidelines for Adults, 2005 (30). | Adults | <ul style="list-style-type: none"> Think of movement as an opportunity, not an inconvenience. Where any form of movement of the body is seen as an opportunity for improving health, not as a time-wasting inconvenience. Be active every day in as many ways as you can. Make a habit of walking or cycling instead of using the car, or do things yourself instead of using labour-saving machines. Put together at least 30 minutes of moderate-intensity physical activity on most, preferably all, days. You can accumulate your 30 minutes (or more) throughout the day by combining a few shorter sessions of activity of around 10–15 minutes each. If you can, also enjoy some regular, vigorous activity for extra health and fitness. |
| USA Be Active Your Way. A Guide for Adults, Based on the 2008 Physical Activity Guidelines for Americans, 2008 (31). | Adults (18–64 years old) | <ul style="list-style-type: none"> Be active your way. Pick an activity you like and one that fits into your life. Find the time that works best for you. Be active with friends and family. Having a support network can help you keep up with your programme. There are many ways to build the right amount of activity into your life. Every little bit adds up and doing something is better than doing nothing. Start by doing what you can, and then look for ways to do more. If you have not been active for a while, start out slowly. After several weeks or months, build up your activities—do them longer and more often. Walking is one way to add physical activity to your life. When you first start, walk 10 minutes a day on a few days during the first couple of weeks. Add more time and days. Walk a little longer. Try 15 minutes instead of 10 minutes. Then walk on more days a week. Pick up the pace. Once this is easy to do, try walking faster. Keep up your brisk walking for a couple of months. You might want to add biking on the weekends for variety. |
| Pacific Region Pacific physical activity guidelines (24). | Adults (18–65 years old) | <ul style="list-style-type: none"> If you are not physically active (moving much), it's not too late to START NOW! Do regular physical activity and reduce sedentary activities. Be active every day in as many ways as you can, your way. Do at least 30 minutes of moderate-intensity physical activity on five or more days each week. If you can, enjoy some regular vigorous-intensity activity for extra health and fitness benefits. |

Age group: 65 years and above

| Country/Region | Target population | Messages used |
|----------------------------------------------------------------------------------------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Australia National Physical Activity Guidelines for Older Adults, 2005 (30). | 65 years and above (Older adults) | <ul style="list-style-type: none"> Think of movement as an opportunity, not an inconvenience. Be active every day in as many ways as you can. Put together at least 30 minutes of moderate intensity physical activity on most, preferably all, days. If you can, also enjoy some regular, vigorous activity for extra health and fitness. Use appropriate safety and protection equipment to maximise safety and minimize risk of injury during physical activity, for example, use supportive footwear for walking, and a helmet for bicycle riding. |
| Canada Canada's Physical Activity Guide for Adults, 1999 (33). | Adults 55 years and above | <ul style="list-style-type: none"> Be active your way, every day – for life. Age is no barrier. Start slowly and build up. Accumulate 30–60 minutes of moderate physical activity most days. Minutes count – add it up 10 minutes at a time. Choose a variety of activities from each of these three groups – endurance, flexibility, strength and balance. Getting started is easier than you think. Build physical activity into your daily routine. Do the activities you are doing now, more often. Walk wherever and whenever you can. Start slowly with easy stretching. Move around frequently. Find activities that you enjoy. |

APPENDIX 4

GUIDELINE GROUP MEMBERS

| Region/Country | Name | Affiliation | Main role of the expert |
|-----------------------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| AFR (Alger) | Dr Rachid Hanifi | Professor of Medicine of Sports Faculty of Medicine of Alger | Content expertise |
| AFR (South Africa) | Dr Vicky Lambert | Professor and Researcher on Bioenergetics of exercise Sports Science Institute of South Africa, University of Cape Town, South Africa | Content expertise |
| AMR (USA) | Dr Janet Fulton | Division of Nutrition, Physical Activity, and Obesity Centers for Disease Control and Prevention, USA | Content expertise |
| AMR (USA) | Dr William Haskell | Professor, Stanford Prevention Research Center, Stanford University School of Medicine Chair of the US Physical Activity Guidelines Advisory Committee | Content and methodological expertise in developing guidelines related to physical activity |
| AMR (USA) | Dr David Buchner | University of Illinois, USA | Content and methodological expertise in developing guidelines related to physical activity |
| AMR (Canada) | Dr Mark Tremblay | Director, Healthy Active Living and Obesity Research (HALO) Scientist and Professor, Department of Pediatrics, University of Ottawa, Canada | Content expertise (specific expertise: 5–17 year olds) |
| EMR (Kuwait) | Dr Jassem Ramadan Alkandari | Chairman of the Physiology department and the Health Sciences Center Faculty of Medicine, Kuwait University | Content expertise |
| EMR (Pakistan) | Dr Shahzad Khan | Assistant Professor, Health Systems; Health Services Academy, Ministry of Health, Islamabad, Pakistan | Content expertise |
| EUR (UK) | Professor Fiona Bull | Researcher, Physical Activity and Health School of Sport & Exercise Sciences, Loughborough University, UK | Methodological expertise in developing guidelines related to physical activity |
| EUR (Finland) | Dr Pekka Oja | Urho Kaleva Kekkonen Institute for Health Promotion Research, Finland (retired) | Content expertise |
| SEAR (Thailand) | Dr Grit Leetongin | Division of Physical Activity and Health Ministry of Public Health, Royal Thai Government | End user (policy-maker) |
| WPR (Australia) | Professor Adrian Bauman* | Director, NSW Centre for Physical Activity & Health School of Public Health, University of Sydney | Methodological expertise in developing guidelines related to physical activity |
| WPR (China) | Dr T H Leung* | Centre for Health Protection, Department of Health, China, Hong Kong Special Administrative Region | End user (policy-maker) |

* Member unable to participate in the meeting held on 23 October 2009 (London, UK).



Accumulation: The concept of meeting a specific physical activity dose or goal by performing activity in short bouts, then adding together the time spent during each of these bouts. For example, a goal of 30 minutes per day can be met by performing 3 bouts of 10 minutes each throughout the day (34).

Aerobic physical activity: Activity in which the body's large muscles move in a rhythmic manner for a sustained period of time. Aerobic activity – also called endurance activity – improves cardiorespiratory fitness. Examples include walking, running, and swimming, and bicycling (34).

Balance training: Static and dynamic exercises that are designed to improve an individual's ability to withstand challenges from postural sway or destabilizing stimuli caused by self-motion, the environment, or other objects (34).

Bone-strengthening activity: Physical activity primarily designed to increase the strength of specific sites in bones that make up the skeletal system. Bone-strengthening activities produce an impact or tension force on the bones that promotes bone growth and strength. Running, jumping rope, and lifting weights are examples of bone-strengthening activities (34).

Cardiorespiratory fitness (endurance): A health-related component of physical fitness. The ability of the circulatory and respiratory systems to supply oxygen during sustained physical activity. Usually expressed as measured or estimated maximal oxygen uptake (VO_{2max}).

Dose: In the field of physical activity, dose refers to the amount of physical activity performed by the subject or participants. The total dose or amount is determined by the three components of activity: frequency, duration, and intensity. Frequency is commonly expressed in sessions, episodes, or bouts per day or per week. Duration is the length of time for each bout of any specific activity. Intensity is the rate of energy expenditure necessary to perform the activity to accomplish the desired function (aerobic activity) or the magnitude of the force exerted during resistance exercise (34).

Domains of physical activity: Physical activity levels can be assessed in various domains, including one or more of the following: leisure-time activity, occupational activity, household activity, and commuting activity (34).

Dose-response: The relationship between the dose of physical activity and the health or fitness outcome of interest is considered the dose-response. The dose can be measured in terms of a single component of activity (e.g., frequency, duration, intensity) or as the total amount. This concept is similar to the prescription of a medication where the expected response will vary as the dose of the medication is changed. The dose-response relationship can be linear, exponential, or hyperbolic, and it is likely to vary depending on the primary measure of interest. For example, improvements in cardiorespiratory fitness, bone health, or adiposity are common dose-response measures of interest. A dose of physical activity may exist below that which no effect has been detected as well as a dose above that which no effect has been detected. These seemingly lowest and highest doses of activity may be called "thresholds," but the term should be used with caution as these apparent limits may be more related to limitations of measurement than to true biological limits (34).

Duration: The length of time in which an activity or exercise is performed. Duration is generally expressed in minutes (34).

Exercise: A subcategory of physical activity that is planned, structured, repetitive, and purposeful in the sense that the improvement or maintenance of one or more components of physical fitness is the objective. "Exercise" and "exercise training" frequently are used interchangeably and generally refer to physical activity performed during leisure time with the primary purpose of improving or maintaining physical fitness, physical performance, or health.

Flexibility: A health- and performance-related component of physical fitness that is the range of motion possible at a joint. Flexibility is specific to each joint and depends on a number of specific variables including, but not limited to, the tightness of specific ligaments and tendons. Flexibility exercises enhance the ability of a joint to move through its full range of motion (34).

Frequency: The number of times an exercise or activity is performed. Frequency is generally expressed in sessions, episodes, or bouts per week (34).

Guidelines and Recommendations: A WHO guideline is any document that contains recommendations about health interventions, whether they are clinical, public health or policy interventions. Recommendations provide information about what policy-makers, health care providers, or patients should do. They imply a choice between different interventions that have an impact on health and that have ramifications for resource use (8).

Health-enhancing physical activity: Activity that, when added to baseline activity, produces health benefits. Brisk walking, jumping rope, dancing, playing tennis or soccer, lifting weights, climbing on playground equipment at recess, and doing yoga are all examples of health-enhancing physical activity (34).

Intensity: Intensity refers to the rate at which work is being performed or the magnitude of the effort required to perform an activity or exercise. Intensity can be expressed either in absolute or relative terms:

- **Absolute:** The absolute intensity of an activity is determined by the rate of work being performed and does not take into account the physiological capacity of the individual. For aerobic activity, absolute intensity typically is expressed as the rate of energy expenditure (e.g. milliliters per kilogram per minute of oxygen being consumed, kilocalories per minute, or METs) or, for some activities, simply as the speed of the activity (e.g. walking at 3 miles an hour, jogging at 6 miles an hour), or physiological response to the intensity (e.g. heart rate). For resistance activity or exercise, intensity frequently is expressed as the amount of weight lifted or moved.
- **Relative:** Relative intensity takes into account or adjusts to an individual's exercise capacity. For aerobic exercise, relative intensity is expressed as a percentage of an individual's aerobic capacity (VO₂max) or VO₂ reserve, or as a percentage of an individual's measured or estimated maximum heart rate (heart rate reserve). It also can be expressed as an index of how hard an individual feels he or she is exercising (e.g. on a 0–10 scale).

Leisure-time physical activity: Physical activity performed by an individual that is not required as an essential activity of daily living and is performed at the discretion of the individual. Such activities include sports participation, exercise conditioning or training, and recreational activities such as going for a walk, dancing, and gardening (34).

Maximal oxygen uptake (VO₂max): The body's capacity to transport and use oxygen during a maximal exertion involving dynamic contraction of large muscle groups, such as during running or cycling. It is also known as maximal aerobic power and cardiorespiratory endurance capacity. Peak oxygen consumption (VO₂peak) is the highest rate of oxygen consumption observed during an exhaustive exercise test (34).

MET: MET refers to *metabolic equivalent* and 1 MET is the rate of energy expenditure while sitting at rest. It is taken by convention to be an oxygen uptake of 3.5 milliliters per kilogram of body weight per minute. Physical activities frequently are classified by their intensity, using the MET as a reference.

Moderate-intensity physical activity: On an absolute scale, moderate intensity refers to the physical activity that is performed at 3.0–5.9 times the intensity of rest. On a scale relative to an individual's personal capacity, moderate-intensity physical activity is usually a 5 or 6 on a scale of 0–10 (34).

Muscle-strengthening activity: Physical activity and exercise, that increases skeletal muscle strength, power, endurance, and mass (e.g. strength training, resistance training, or muscular strength and endurance exercises) (34).

Physical activity: Any bodily movement produced by skeletal muscles that requires energy expenditure (5).

Physical inactivity: An absence of physical activity or exercise.

Primary prevention: Actions that seek to reduce risks in the entire population regardless of each individual's level of risk and potential benefits. The intention of primary prevention interventions is to move the profile of the whole population in a healthier direction. Small changes in risk factors in the majority who are at low to moderate risk can have a significant impact in terms of population-attributable risk of death and disability (6).

Secondary prevention: Focuses actions on the people likely to benefit, or benefit most. Secondary prevention interventions are based on screening exposed populations for the early onset of sub-clinical illnesses and administering treatment (6).

Sport: Sport covers a range of activities performed within a set of rules and undertaken as part of leisure or competition. Sporting activities usually involve physical activity carried out by teams or individuals and are supported by an institutional framework, such as a sporting agency (24).

Vigorous-intensity physical activity: On an absolute scale, vigorous intensity refers to physical activity that is performed at 6.0 or more times the intensity of rest for adults and typically 7.0 or more times for children and youth. On a scale relative to an individual's personal capacity, vigorous-intensity physical activity is usually a 7 or 8 on a scale of 0–10 (34).

Major muscle groups: Major muscle groups include the legs, hips, back, abdomen, chest, shoulders and arms (34).

Type of physical activity: The mode of participation in physical activity. The type of physical activity can take on many forms: aerobic, strength, flexibility, balance.

Volume: Aerobic exercise exposures can be characterized by an interaction between bout intensity, frequency, duration, and longevity of the programme. The product of these characteristics can be thought of as volume and can be represented by the total energy expenditure (EE) of the exercise exposure (34).

APPENDIX 6

LIST OF PEER REVIEWERS (IN ALPHABETICAL ORDER)

Dr Randy Adams (Centre for Health Promotion, Public Health Agency of Canada, Canada)
Ms Frances Cuevas (Department of Health, Philippines)
Dr Luiz Gomez (Fundación FES in Bogotá, Colombia)
Mr Benaziza Hamadi (World Health Organization, Switzerland; retired)
Professor I-Min Lee (Harvard School of Public Health, USA)
Dr Sonja Kahlmeier (Institute for Social and Preventive Medicine of the University of Zurich, Switzerland)
Dr Bill Kohl (University of Texas School of Public Health, Michael & Susan Dell Center for Advancement of Healthy Living USA)
Professor Salome Kruger (Centre of Excellence for Nutrition, North-West University, South Africa)
Dr Jean Claude Mbanya (Department of Internal Medicine and Specialties, University of Yaoundé; International Diabetes Federation, Cameroon)
Dr Karim Omar (Institute for Sport Science and Sport; FA University Erlangen-Nürnberg Germany)
Dr Vincent Onywera (Kenyatta University, Nairobi, Kenya)
Dr Michael Pratt (Centres for Disease Control and Prevention, USA)
Dr Krissada Raungarrearat (Thai Health Promotion Foundation, Thailand)
Professor Nizal Sarrafzadegan (Isfahan Cardiovascular Research Center; Isfahan University of Medical Science Iran)
Dr Trevor Shilton (Australian Heart Foundation, Australia)
Professor Nick Watson (Department of Sociology, Anthropology and Applied Social Sciences University of Glasgow UK)
Dr Wanda Wendel-Vos (Centre for Prevention and Health Services Research; National Institute for Public Health and the Environment, the Netherlands)

APPENDIX 7

WHO REGIONAL OFFICES CONSULTED

AFRO (Dr Hamas Boureima-Sambo; Dr Sidi Allal Louazani; Dr Chandralla Sookram)
AMRO/PAHO (Dr Carl James Hospedales; Dr Enrique R Jacoby)
EMRO (Dr Jaffar Hussain)
EURO (Ms Lideke Middelbeek; Dr Sonia Kahlmeier, until December 2009; Ms Trudy Wijnhoven)
SEARO (Dr Jerzy Leowski)
WPRO (Dr Andrew Colin Bell; Dr Luca Tomaso Cavalli-Sforza; Dr Cherian Varghese)

WHO-HQ
Department of Chronic Diseases and Health Promotion (Dr Gauden Galea; Dr Shanthi Mendis)
Department of Ageing and Life Course (Dr John Beard)
Department of Nutrition for Health and Development (Dr Francesco Branca)
Department of Protection of the Human Environment (Dr Maria Purificacion Neira)
Department of Child and Adolescent Health and Development (Mr Paulus Joannes Bloem)

APPENDIX 8

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WPRO, South Pacific Office: Dr Temo Waqanivalu

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