Non pharmacological treatments in elderly diabetics

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Abstract

Among the therapeutic resources available for the elderly diabetic, diet and exercise are often neglected because patients are reluctant to make changes and significant amount of time of healthcare providers and physicians is required for patient education. Diet and exercise work in synergy to lower the biological parameters of diabetes control. Diet in the elderly diabetic patient is based essentially on the nutritional recommendations for the elderly subject, diabetic or non diabetic. Recent studies on exercise demonstrate the value of resistance training in increasing muscle mass, preferably over endurance training. The benefits obtained also involve autonomy and quality of life. Taking up exercise is not devoid of disadvantages because of the frequent co-morbidity at this age.

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Résumé

Traitements non médicamenteux du diabète chez le patient âgé.

Parmi les moyens thérapeutiques du diabète chez le patient âgé, la diététique et l’activité physique sont souvent négligées, car elles se heurtent à la réticence du patient et nécessitent du temps d’éducation de la part des soignants et du médecin. Ces deux moyens sont synergiques pour abaisser les paramètres biologiques de contrôle du diabète. La diététique chez le patient âgé diabétique reprend essentiellement les recommandations nutritionnelles destinées au sujet âgé, qu’il soit diabétique ou non. Les récents travaux sur l’activité physique mettent en évidence l’intérêt de l’entraînement en résistance pour accroître la masse musculaire, de préférence à l’entraînement en endurance. Les bénéfices obtenus concernent également l’autonomie et la qualité de vie. La reprise d’une activité physique n’est pas dénuée d’inconvénients, du fait de la co-morbidité fréquente à cet âge.

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Key words: Diabetes mellitus; Elderly; Diet; Physical activity; Therapeutic

Mots-clés : Diabète ; Sujet âgé ; Diététique ; Activité physique ; Thérapeutique

Non pharmacological treatment of diabetes mellitus, whatever the patient’s age, combines diet and exercise. These two therapeutic resources have been – and remain – underused for several reasons:

– they require daily motivation from the patient and his family to have a positive impact on controlling the disease;
– they require motivation from the physician and healthcare providers, who must devote time to teaching the patient and his family a minimum of information on diabetes and exercise;
– the effectiveness of diet and exercise are often presented as being inferior to the efficacy of medications, because this is based only on the evaluation of blood glucose or HbA1c, whereas the expected benefits go far beyond the improvement of these parameters. Diet and exercise have several repercussions on muscle mass, functional autonomy, blood lipids, digestion, feeling of well-being, etc.;
– finally, diet and exercise have limits and/or disadvantages, particularly because of the nearly constant co-morbidities present at advanced ages. Nevertheless,
they should not be neglected, given the high frequency of iatrogenic drug accidents in the elderly population.

The scientific literature on these two subjects is notably different: the poverty of the literature on the elderly diabetic’s diet contrasts with the increasing interest in the effects of exercise.

1. Diet of the elderly diabetic

1.1. General principles in the diet of the elderly patient

Failing a consensus based on randomized studies conducted on elderly diabetic patients, we will review here the expert recommendations on the diet for the elderly subject, diabetic or non diabetic, and on the nutrition of the elderly patient in two particular situations: institutionalization and oxidative stress.

The geriatric physician’s major worry in terms of diet in the elderly patient is limiting the risk of denutrition. Denutrition is a major factor of poor prognosis. It is estimated that denutrition affects 4% of the elderly population living at home and 10% of the subjects over 80 years of age, but its prevalence rises to 50% at the admission on an acute medical unit [1]. Obesity is less frequent in the elderly subject, at least today, because of the excess mortality due to this disease in the younger adult, but its prevalence could increase in advanced ages during the coming decades [2]. However, obesity remains a risk factor for the onset of diabetes after 75 years of age [3].

The diet recommendations designed for the elderly diabetic are based on well-known notions on the metabolism of older subjects, the eating habits frequently observed in advanced age (loss of taste for certain foods, refusal to eat new foods, reduction of calorie intake because of a reduction in physical activity, changes in chewing capacity, etc.), and finally the need for meals to remain pleasurable.

1.2. Quantitative recommendations

– **Calorie intake:** In the elderly patient, calorie intake must not be restricted and a stable weight should be sought, even in the obese subject. Any attempt to lose weight may result in a loss of lean mass – mainly skeletal muscle – and in a high risk of loss in the activities of daily living. In the obese subject, the abundance of fat mass can hide severe denutrition. The total calorie intake should be approximately 30 Kcal/kg ideal body weight/day. Dietary studies conducted on older subjects have shown that the number of meals is often reduced, with breakfast retained, but a drastic reduction in calories in the evening. The elderly diabetic patient should be persuaded to keep three true meals a day. These meals can be reduced in volume with snacks between meals for better acceptance.

– **Carbohydrate intake:** As in the young adult, carbohydrates should contribute for at least 50% of total calories. The percentage of carbohydrates in elderly subjects is often lowered [4]. Maintaining snacks between meals can be warranted, independently of the duration of action of the glucose-lowering medications used, because older patients accept small food intakes better.

– **Protein intake:** In 2000, the recommended protein intake for the French elderly population was maintained at 1 g/kg body weight/day, whereas it was lowered to 800 mg/kg body weight/day for the young adult population.

– **Lipid intake:** Lipids are the vectors of taste in foods. There is no reason to severely restrict their intake in most elderly diabetic patients.

– **Calcium intake:** Recommended calcium intake should be 1,200 mg/day (French recommendations) – between 1,000 and 1,500 mg/day (US recommendations) – to reduce the risk of osteoporotic fracture [5]. The active part of digestive absorption of calcium disappears in the older subject; only passive absorption persists, depending entirely on the quantity of calcium present in the intestinal lumen [6]. It is estimated that 80% of the elderly population does not satisfy these recommendations [1]. Taking at least one dairy product per meal should be encouraged, or calcium supplements should be prescribed in drug form, usually associated with vitamin D in the same preparation.

– **Sodium intake:** There is no need to impose a salt-free diet that is not justified by a heart condition (resisting to a properly followed medical treatment), a kidney condition, or a liver condition. This type of restriction can lead to anorexia.

– **Vitamin D intake:** Insufficient vitamin D in the normal diet, the lack of exposure to the sun, the reduction in the skin’s synthesis of vitamin D and the reduction in the 1,25(OH)2D synthesis in the kidney [6] expose the elderly subject to a vitamin D deficiency, to the detriment of calcium absorption and bone mineralization. Vitamin D deficiency also increases the risk of falling because of the lack of vitamin D’s influence on muscle action [7]. An elderly subject with insufficient exposure to the sun should receive 800 IU of vitamin D per os every day (or a load of 100,000 IU per os every 4 months) [5].

– **Vitamin C intake:** In geriatric institutions, the consumption of fresh fruit is often reduced (problems with peeling fruit, poor dental health). It is possible to remedy this situation in giving orange juice with guaranteed vitamin C content.

– **Fiber intake:** Fibers slow gastric emptying and accelerate intestinal transit. It has a theoretical beneficial effect on postprandial blood glucose levels, but the foods containing fiber (fruits, vegetables, and grains) require healthy teeth to be consumed, which is not...
always the case in the elderly population. The recommended intake is 30 g/day [8].

- Fluid intake: Drinking should be encouraged (at least 1.5 l/day), even more in a hot atmosphere or during periods of fever. The risk of dehydration is high because of the reduction in the thirst sensation [9]. If blood glucose control is insufficient, glycosuria induces osmotic diuresis and raises the risk of dehydration.

There are no other quantitative recommendations specific to the elderly subject.

1.3. Qualitative recommendations:

One must keep in mind that in the elderly subject, excessive restrictions should be avoided and certain life pleasures should be favored.

- Carbohydrate intake: Consumption of complex carbohydrates should be encouraged. Simple carbohydrates are authorized if they are compatible with the daily glucose ration and consumed in the middle or at the end of the meal. They are a source of eating pleasure. Consumption of dishes containing simple sugars by elderly institutionalized diabetics does not change the HbA1c level at 6 months [10].

- Respect the patient’s tastes: The elderly diabetic’s tastes should be respected, even if they move away from the ideal diet. An elderly subject has greater difficulty adapting to a new restriction; a banned food may not be replaced with a new food contributing the same nutrients.

- So-called “diet” foods: These should not be recommended. They are often expensive and do not have an important positive effect on blood glucose control.

- Encourage social interaction: Social interaction increases appetite. An elderly subject should not be set apart with on the pretext of a diabetic diet. Merry meals are authorized, under the condition of a closer blood glucose control. Alcoholic beverages must not be banned (to be consumed in reasonable quantities) if they are a source of pleasure. These measures allow the elderly diabetic to preserve a good quality of life.

1.4. Particular situations

1.4.1. The elderly diabetic patient in a geriatric institution

Life in an institution is a source of restrictions that can affect diet intake and the equilibrium of the diabetic patient:

- unusual meal times (evening meal too early and prolonged nighttime periods without eating);
- mismatch between the institution’s menus and the patient’s tastes or the patient’s religious or philosophical convictions;
- safety imperatives (cooking, cooling then reheating foods) reducing the food’s vitamin C content and palatability;
- diabetic patient losing autonomy and becoming dependent on the availability and the motivation of the healthcare personnel.

The institution’s coordinating physician is responsible for training healthcare personnel to the dietary imperatives of elderly diabetic patients, normally 25%-30% of the residents. Like the non diabetic subject, the elderly diabetic patient can probably benefit from food similar to the food consumed at home [11].

1.4.2. Co-morbidity in the elderly diabetic patient

- Acute situations: Hospitalized elderly diabetic patients often have an associated inflammatory syndrome: infections, myocardial infarction, or surgery. In these stressful conditions, blood glucose control deteriorates. Intensive insulin therapy and frequent capillary blood glucose testing in an attempt to obtain normal blood glucose levels improve prognosis [12]. If the patient continues to eat orally, the carbohydrate-protein ratio must be maintained, even increased and spread throughout the day.

- Benefits of oral food supplements: Oral food supplements enriched in proteins are generally beneficial in many pathological situations (bedsore treatment, cancer, and peri- or post-surgery phases) [13]. The only reservation is that they require the patient to have normal swallowing ability.

- Benefits of enteral tube nutrition: Many situations warrant enteral nutrition in older patients (diabetic or non diabetic): swallowing impairment, lack of consciousness, severe and longstanding denutrition, anorexia, cancers, infections, etc. As a general rule, enteral nutrition should be reserved for patients in whom there is hope for a return to normal feeding: this is the case in the immediate follow-up of a stroke, although there is always an uncertainty as to the later recuperation. Every time that enteral nutrition is planned via nasogastric or percutaneous tube, one must distinguish the healthy elderly from the frail elderly. Like younger patients, the former benefit from enteral nutrition. The latter frequently have decubitus and aspiration pneumonia complications (30% to 58% in patients with dementia) [14-15]. In this fragile population, it is preferable to make do with oral nutritional supplements. The benefits of enteral tube feeding in elderly patients are still being debated in the literature [13].

In conclusion: The dietary objective in the elderly diabetic patient is to preserve a good nutritional status, improve the quality of life, and encourage social interaction. In an older diabetic patient, it is often more effective to adapt medical treatment than to impose an overly restrictive diet [16]. This is particularly true in institutions, where older diabetic patients are fragile and at risk of developing denutrition. In
acute situations, like the non diabetic elderly, elderly diabetic patients benefit from oral food supplements enriched in proteins, with the condition that blood glucose control is maintained. However, in the same situations, enteral tube feeding has not reached consensus in terms of the high risk of aspiration pneumonia in fragile elderly patients.

2. Exercise in the elderly diabetic

As in the young adult, exercise is an important component of treatment, but the physical limitations related to age often reduce the possibility to exercise. According to a study conducted in the United States, the tendency toward inactivity dropped from 1994 to 2004, from 27.9% to 21.4% in men and from 31.5% to 25.9% in women [17]. In 2004, the greatest prevalence of inactivity (>30%) was observed in men and in women who were 70 years-old and older [17]. Since inactive subjects are at a high risk of disability, loss of muscle mass, flexibility, and balance, all resulting in falls, the information available on the possibilities for exercise in the older subject must be increased [18]. A Swedish study, however, shared some concern about this attitude [19]: in 48 subjects over 60 years of age with type 2 diabetes, the majority of them (39/48) had other diseases or treatments that made exercise difficult and/or interfered with the interpretation of training programs. Aerobic capacity, glucose tolerance, and lipid levels were measured in eight men with type 2 diabetes and in eight controls, having the same weight, matched for age, and taking part in no exercise. After two years, oxygen consumption was increased by 16% in the active group and decreased by 12% in the control group. However, no significant difference was observed for weight, glucose tolerance, and fasting glucose and lipids. Two patients developed coronary disease, two had metabolic deterioration, and two gave up the exercise program. The authors question the feasibility and effectiveness of physical training over the long term in the older subject.

It is therefore important to select older patients who are able to undertake regular exercise. The Fremantle study, conducted in Australia, provided interesting results on type 2 diabetic subjects aged 64 ± 11 years [20]. After 4.5 years of follow-up, 28.5% of subjects in group 1 had developed new mobility impairment and 18.1% in group 2 had developed new ADL disability, respectively [20]. The risk for reduced mobility increased with age (6%/year), as well as peripheral neuropathy (40%/year), stroke history (123%), insulin treatment (117%), or arthritis (82%). The risk of having limitations with daily activities was increased by baseline mobility problems with mobility (222% increase), stroke (92%), claudication (67%), and depression (41%), and was also influenced by age, smoking or lack of exercise. The complications of diabetes are therefore an obstacle to taking part in exercise.

2.1. What types of exercise are appropriate for the elderly subject?

There are two types of exercise: endurance training (cycling, treadmill, rowing machine, step aerobic exercise) or resistance training (working upper and/or lower body muscles with weight lifting). Endurance training increases lipolysis and reduces fat mass, whereas resistance training favors an increase in muscle mass. Although the first activity is easier to put into practice in the elderly subject, the second fits better with reduced mobility. Finally, combining the two, when possible, is ideal because of the increase in fat mass and sarcopenia related to age.

General precautions should be taken, even more so at this age: the recommended duration is 30 min at least, with 5-10 min of warm-up to reduce muscular and osteoarticular pain before beginning exercise and an active cool-down period lasting 5-10 min to prevent the risk of orthostatic hypotension after exertion (walking after running, pedaling at a low resistance after cycling). Three sessions a week seem to be a minimum, given the “memory” of glucose transporters in the muscles (GLUT 4). There are also some tricks to fight against sedentariness, valuable at any age: choose the stairs rather than the elevator, get off the bus one stop early and walk the rest of the ways, park at the far end of the parking lot, etc.

2.2. What have we learned from the studies published on elderly subjects?

The quality of the studies is generally compromised due to a low number of subjects included and/or the short duration of the applied program.

An indoor aerobics physical exercise program was proposed by a Canadian team [21]. Nineteen type 2 diabetes subjects (mean age: 69 years), seen on an out-patient basis and with no acute disease in the six preceding months, were compared (after randomization) to 20 matched controls. HbA1c and fructosamine levels, 3h oral glucose tolerance test (OGTT), treadmill test and self-administered questionnaire on quality of life were evaluated at the beginning and after week 16. Subjects in the control group received instructions to continue with their usual activity regimen. The treadmill test was performed as follows: after an adaptation period with no slope lasting 10-30 s at 2.25 mph, then 2 min at 2.5 mph, the slope was increased by 3° at each successive period (total: 6–12 min), the subjects being allowed to stop whenever they wished. Meanwhile an ECG was recorded and the blood pressure measured. Physical exercise program was applied three times a week under supervision during 16 weeks. Each session comprised: 10-min warm-up, rapid walking for 20 min, a strength and endurance part of two sets of 10 repetitions of movements of major muscle groups (20 min), and finally stretching exercises and relaxation (10 min). No diet recommendations were given. At inclusion, the HbA1c level was 7.5%
(experimental group) and 7.3% (control group), with the duration of type 2 diabetes 51 months and 102 months duration of type 2 diabetes, respectively. The body mass index (BMI) was approximately 30 kg/m² in both groups and in the majority of cases treatment consisted of an association of glyburide and metformin. At 16 weeks, in the experimental group, the area under the glucose curve during the OGTT dropped significantly and the time spent on the treadmill increased. Female sex, higher BMI and HbA₁c level, were factors associated with a positive response.

As in younger subjects, aerobic exercise increased muscle blood flow and allows a better glucose uptake in the muscle, lowering insulin resistance. In elderly obese subjects (73 years), insulin resistance (reduction in insulin-stimulated glucose uptake) is increased [22]. Similar results were observed by the same team in other elderly normal-weight subjects (74 years) but with normal weight [23]. A study similar to the Canadian study (one session/week for three months, then two sessions/week with dietary advice) in 64 overweight Afro-American subjects, with a mean age of 62 years, in 12 weeks showed a 2.8% reduction in weight and a 1.1% reduction in HbA₁c (initial level >10%) [24].

As an alternative to the endurance muscle exercise, which is not always possible (obesity, artheros, cardiovascular status), resistance training can be proposed. The exercises should be repeated with moderate weights. An American study [25] applied resistance training for 6 months at 75%-85% of maximum strength to male and female subjects with a mean age of 67 years. Sixteen subjects (ten men and six women) benefited from intense exercise and a moderate diet program (<30% of total calories in fat and <10% in saturated fats, for a projected weight loss of 0.25 kg/week), whereas 13 control subjects (six men and seven women) received a standard exercise program and the same diet program. A 3-day diet survey was conducted at three and six months. The mean BMI was 31.5 and 32.5 kg/m², respectively. The indoor exercise took place three times a week on nonconsecutive days. After five min of warm-up on the stationary bicycle (low resistance), a high-resistance period (50%-60% 1-RM), then after two weeks 75%-85% 1-RM) was performed on a weight machine with increasingly heavy weights followed by five min of rest (*1-RM is defined as the maximum load that can be used during the exercise period over a single repetition). Nine exercises were done three times at each monitored session: bench press, leg extension, upright row, lateral pull-down, standing leg curl (ankle weights), dumbbell seated shoulder press, dumbbell seated biceps curl, dumbbell triceps kickback, and abdominal curls. Eight to ten repetitions were done with two min of rest between repetitions. The control program included the stationary bicycle (five min at low resistance), then 30 min of stretching. HbA₁c fell significantly more in the first group at three months (0.6%) and six months (1.2%) (vs. 0.07% and 0.4% in the second group). Weight loss at six months was not different in the two groups (respectively, 2.5 kg and 3.1 kg), as for fat mass (respectively, 2.4 and 2.7 kg), but lean mass increased in the first group (+0.5 kg if resistance training) and decreased in the second (–0.4 kg). Waist measurement decreased identically at six months in both groups (respectively, –6.9 cm and –6.7 cm). There were no between-group differences for fasting blood glucose insulinemia, blood lipids, or resting blood pressure. This technique, which can improve blood glucose control in elderly diabetic subjects, is attainable and effective, with adhesion to the program by 88% and 85% of the subjects in the two groups. Maintaining sufficient muscular strength is particularly important in the older subject. It is unfortunate that the mean age in this study was relatively low (67 years).

Another randomized study was conducted over 16 weeks on 62 community-dwelling Latino subjects (40 women and 22 men) in the US, with a mean age of 66 ± 8 years: one group with progressive resistance training (PRT) and one control group [26]. Exercise took place in a specialized center three times per week. Each supervised session lasted 45 min: five-min warm-up (six chair stands and a 1-min brisk walk around the exercise facility), 35 min PRT using five pneumatic resistance training machines (chest and leg press, upper back, knee extension, and flexion), and 5-min cool-down (flexibility and stretching exercises). Each subject performed three sets of eight repetitions on each machine per session. Intensity varied from 60% to 80% 1-RM from weeks 1 to 8, and from 70% to 80% 1-RM during weeks 10-14, except during weeks 9 and 15 (10% less energy) so as to limit the risk of injury and overtraining. The main objective was blood glucose control and the secondary objectives were muscle strength and muscle glycogen reserves. In subjects participating in muscle strength exercise, 72% decreased their HbA₁c levels (from 8.7% to 7.6%), increased their glycogen stock (from 60 to 79 mmol glucose/kg of muscle), and reduced the number of medications. At the other extreme, in control subjects, HbA₁c remained unchanged, glycogen decreased (from 61 to 47 mmol glucose/kg of muscle), and the number of medications increased. During exercise, the lean mass increased +1.2 kg vs –0.1 kg, systolic blood pressure (SBP) dropped by –9.7 mmHg vs +7.7 mmHg, and the trunk fat mass decreased by –0.7 kg vs +0.8 kg. High-intensity resistance exercise is therefore effective in improving blood glucose control with increased lean mass and lowered abdominal fat and SBP. HbA₁c dropped twice as much with high-intensity resistance exercise than with moderate-intensity resistance exercise [27]. The price to pay for these positive effects was the occurrence of five hypoglycaemic episodes immediately after exercise, similar to what has been observed in other types of exercise, and three episodes of chest pain, which demonstrates the need for monitoring these subjects during exercise and screening for coronary lesions before beginning the program.
2.3. What happens to these beneficial effects of this resistance training if it is pursued at home?

A recent publication answers this question [28]. A 12-month randomized study on 36 sedentary, overweight (27< BMI< 40 kg/m²) type 2 diabetic subjects (21 men and 15 women), 60-80 years of age, combined two phases: six months of a weight-loss diet program with progressive high-intensity resistance training (identical methodology applied as in the study by Dunstan’s study et al. [25]) compared to six months of a weight-loss diet with a control exercise program. After six months, the supervised gymnasium-based resistance exercise program was followed by six months of home-based resistance training done at home three days a week (weightlifting). Nine weightlifting exercises were done with ankle and abdominal presses. HbA₁c, body composition, and muscle strength values, were compared between the intensive resistance training group and control groups. In the first group, at six months, the reduction in HbA₁c was greater (~0.8%) compared to the control groups. In the first group, at six months, the reduction in HbA₁c was greater (~0.8%) compared to the control group, but this effect was not observed at 12 months, after home training. On the other hand, the greatest increase in lean body mass (measured by dual energy x-ray absorptiometry [DEXA]) of the first group (+0.9 kg) at six months was significantly maintained at 12 months (+0.8 kg), as was upper and lower body muscle strength at 12 months. No difference appeared between the two groups at six or 12 months in terms of weight, fat mass, blood glucose, or fasting insulinemia. It can therefore be concluded that resistance training at home preceded by a learning phase at the gymnasium is effective in increasing lean body mass and muscle strength, but not in maintaining blood glucose control. Reductions in adherence and exercise training volume (shortened by 50%) and intensity seem to impede the effectiveness of home-based training for maintaining improved glycemic control.

Recently, it was shown [29] in nine men aged a mean 67 years, that a 16-week program of resistance exercises performed twice a week, with no particular diet restrictions, improved insulin sensitivity by 46% (estimated by the Bergman minimal model), reduced abdominal fat mass (~10.3%) and fasting blood glucose (from 1.47 to 1.35 g/l). Access to adapted, although expensive machines, is an additional limitation to this method when it is undertaken at home.

Among consequences of exercise and weight loss, a reduction in bone mineral density could be observed [30]. Following the methodology described above (supervised high intensity resistance training RT added to a moderate weight loss program WL compared to moderate weight loss alone) [25, 28], 36 sedentary, overweight adults aged 60 to 80 years were randomized to either a supervised gymnasium-based RT + WL or WL alone program for 6 months. Thereafter, all participants completed an additional 6-month home-based training without further dietary modification. Total body composition, regional BMD, bone mineral content, fat mass and lean mass were assessed by DEXA, at six months and at one year. During the first 6-month period, weight loss and fat mass loss were similar in the two groups RT + WL (n=16) or WL alone (n=13), with an increase in lean body mass in RT + WL vs WL alone (difference 1.8%). Bone density and the bone mineral content were stable with exercise combined with diet, but decreased (0.9% and 1.5%, respectively) with diet only. After home-based exercise for six months, weight and fat mass increased significantly in the initial group (exercise + diet, n=14), as well as in the diet only group (n=12), with no changes in lean body mass, bone density, or bone mineral content. Despite the low number of subjects and the short observation period, maintaining optimal bone mass in case of weight loss seems to necessarily associate physical exercise (resistance training) to optimize the effects on body composition without having a negative effect on bone.

In summary, the well-known problems encountered for adhering to a prolonged exercise program in young overweight diabetic subjects are also observed in older subjects. The frequency of disabilities was recently brought out in an Italian study [31]: in 5632 subjects older than 65 questioned on their physical disabilities (declarative method), a relation was found between diabetes and physical disability in daily life in women (odds ratio, OR 1.65 [1.22–2.23]), but not in men (OR 1.21 [0.84–1.75]), after adjusting for age, education, and BMI. Inversely, the association between diabetes and severe or total physical disability, evaluated on physical tests, was positive and strong in both sexes: OR 2.81 [1.44–5.41] in women and OR 2.16 [1.25–3.73] in men.

There are only a few studies that enroll a small number of motivated subjects with no disability. The best solution for healthy elderly diabetic subject remains to be found, but aerobic and resistance exercise are both effective, with an advantage for the resistance exercise method able to postpone sarcopenia. In case of disability (knee osteoarthritis), older disabled (non diabetic) persons have modest improvements in measures of disability, physical performance and pain from participating in either an aerobic or a resistance exercise program. However the authors concluded by stating that exercise should be prescribed as part of the treatment [32]. Of the methods that can be easily applied to all ages, Tai Chi, a type of Chinese gymnastics [33], and the mechanical horse [34] can be cited. There are no data on the use of Tai Chi in elderly diabetic subjects, although this should be investigated. In their review on the subject, Wang et al. [33] complained about the lack of controlled studies (9/47), but stressed the interest of Tai Chi in improving well-being, balance, and flexibility in older patients with chronic conditions. A study with an euglycaemic clamp in nine diabetic subjects aged 65 ± 3 years (mean BMI: 22.8 kg/m²) using mechanical horse demonstrated that 30 min of mechanical horseback riding over 12 weeks significantly improved insulin sensitivity, but it returned to its initial level three months after exercise cessation. A reduction in fat mass and an increase in lean mass were associated with the exercise, with no changes in HbA₁c. Life is a circle: our
childhood is spent on wooden horses and could end with
exercise on a mechanical horse from which it would be bet-
ter not to fall!

Perceived quality of life reported by a large population
of type 2 diabetics (n=2,056) was lower in cases of inactivity
and advanced age [35]. After controlling for demographic
(age, sex, education level, income) and medical data (dia-
betes complications), multiple regression analysis found only
the low level of activity to explain this result. Promoting
exercise in the older subject would therefore add to the usual
benefits (better diabetes control, retaining muscle mass,
reducing fat mass and insulin resistance), an improvement
in quality of life, and a greater chance for healthy aging.
Questionnaires aim at aptitude for physical exercise exist, but
they are not specific to the elderly population (they can be
applied to subjects from 15 to 69 years of age): they are
based on seven questions (see Annex 1). The uncertainties
concerning the type of activity, which should be adapted not
only to the individual’s physical abilities, but also to the
duration of the exercise and particularly in long-term main-
tain which is not limited to this age group, but rather ampli-
ified by age. Group sessions that are organized for patients
experiencing healthy aging (aerobic and resistance train-
ing) can take advantage of group dynamics. However, for
the fragile elderly, often institutionalized, maintaining physi-
cal passive therapy should undoubtedly be emphasized, but
such projects require financial and human resources that are
rarely accessible.

3. Conclusion

Non pharmacological treatments, i.e., diet and exercise, for
elderly diabetic patients obtain results comparable to those
of antidiabetes medications: a 1% HbA1c level reduction is
considered successful. The effects of these two types of
treatment are additive and allow a greater benefit. The
advantages of non drug treatments, mainly exercise, are
measured not only on biochemical parameters, but also on
several aspects: increase in muscle mass, decrease in fat
mass, and moreover improvement in autonomy and quality
of life [35]. Abandoning an effective non medical treatment
means a return to the earlier condition, as for drugs. Adverse
effects of exercise exist, heightened by age: they should be
screened for and monitored, but their generated cost has not
yet been evaluated.

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Annex 1

Q-AAP and you (a questionnaire for people from 15 to 69 years of age), partially reproduced here.

For more detailed information, see “activité physique et santé – PNNS” on the web site www.sante.gouv.fr (Theme “nutrition”)

Answer “yes” or “no” to the following seven questions:
1) Has your doctor told you that you suffer from a cardiac disease and that you should not participate in the physical exercise prescribed and approved by a doctor?
2) Do you experience chest pain when you exercise?
3) In the last month, have you experienced chest pains between periods of physical exercise?
4) Do you experience balance problems related to dizziness or have you lost consciousness?
5) Do you have bone or joint problems (for example, in the back, knees, or hips) that could worsen if you increased your physical exercise?
6) Are you taking any prescribed drugs for blood pressure or heart disease (for example, diuretics)?
7) Do you know of another reason for not participating in physical exercise?

If you have responded yes to one or several questions, consult your doctor BEFORE increasing your physical exercise and BEFORE having your physical condition evaluated.