

## Review

# The Rehabilitation Role in Chronic Kidney and End Stage Renal Disease

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## Key Words

Chronic kidney disease • Disability • Rehabilitation • Exercise • Hemodialysis

## Abstract

Chronic kidney disease (CKD) worldwide is rising markedly becoming a priority public health problem. The progression of CKD cause functional limitation and severe disability with poor quality of life. The aim of present review was to highlight the effect of rehabilitation in CKD and ESRD subjects. The rehabilitative process is unique in treating disabled people according to a holistic approach with the aim of supporting a person's independent living and autonomy. CKD are associated with an increased risk of functional impairment, independent of age, gender, and co-morbidities. Clinicians should counsel patients with CKD including frail elder people to increase physical activity levels and target that regular physical activity including aerobic or endurance exercises training benefits health. In old subjects with CKD and multiple functional impairments, the traditional disease based model should be changed to individualized patient-centered approach that prioritizes patient preferences. Patients receiving haemodialysis have a considerably lower exercise tolerance, functional capacity, and more muscle wasting than healthy subjects or patients with less severe CKD. Exercise training or comprehensive multi-dimensional strategy and goal-oriented intervention should be also provided in ESRD older subjects. Structured prevention programs based on reducing the risk factors for CKD and rehabilitative strategies could reduce disability occurrence.

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## Introduction

### *The burden of the chronic kidney disease*

Since 2002, the chronic kidney disease (CKD) is defined as the presence of kidney damage or reduced glomerular filtration rate (GFR) less than 60 mL/min/1.73 m<sup>2</sup> that is present for three months or more [1]. According to GFR, there are five stages of CKD from 1 to 5 with GFR > 90 mL/min/1.73 m<sup>2</sup> (kidney damage with normal or increased kidney function) through GFR < 15 mL/min/1.73 m<sup>2</sup> (kidney failure and haemodialysis), respectively. Age,

hypertension, and diabetes are the key predictors of new onset secondary CKD. The high prevalence and incidence of CKD and end-stage renal disease (ESRD) is a global challenge. A recent epidemiological survey in a large population sample showed that the overall incidence of a definite diagnosis of CKD was 479 per 100,000 person-years [2]. Furthermore, studies from around the world have reported a broadly similar prevalence between 10% and 16% in adults [3] depending on the diagnostic criteria used. The number of patients with CKD worldwide is rising markedly becoming a priority public health problem. The rise in CKD worldwide most probably reflects the global epidemic of type 2 diabetes and the ageing of the populations in developed countries, with a higher incidence and prevalence in elderly people. The incidence of CKD has been shown to increase with age and nearly half of old people suffers from this condition [4, 5]. Likewise, the prevalence of CKD varies from 23.4% to 35.8% in people aged 64 years or older [6]. Because high income countries population is dramatically changing as the elderly represent the fastest growing demographic segment, it is predictable that a large number of old subjects suffering from CKD and ESRD will need care and assistance. Furthermore, the number of people with diabetes worldwide, currently around 154 million, is set to double within the next 20 years, and the increase will be most notable in the developing world. The progression of CKD cause functional limitations and severe disability with poor quality of life that require proper rehabilitative strategies, particularly in old people [7] who also suffer from several co-morbidities. The transition from CKD to ESRD constitute high clinical risk situations with substantial healthcare costs. Despite patients with ESRD comprise only a small percentage of people with CKD [8], the cost of treating these patients is substantial and poses a great challenge to provision of care. In Europe, less than 0.1% of the population needs renal replacement therapy, which accounts for 2% of the healthcare budget [9]. Structured and well resourced primary prevention programs based on reducing the risk factors for CKD and rehabilitative strategies adjunct to proper interventions during the renal disease could make a big difference in reducing the impact that CKD will predictably have on disability occurrence and related social cost [10]. The aim of present review was to highlight the role and effect of rehabilitation in CKD and ESRD subjects.

### **Rehabilitation role and rehabilitative project**

Rehabilitation has been defined by the World Health Organization (WHO) as "the use of all means aimed at reducing the impact of disabling and handicapping conditions and at enabling people with disabilities to achieve optimal social integration". This definition incorporates clinical rehabilitation but also, importantly, endorses the concept of social participation as requiring a matching of the social environment to the needs of people with disabilities. The overall aim of rehabilitation is to enable people with disabilities to lead the life that they would wish, given any restriction imposed on their activities by impairments resulting from illness or injury as well as from their personal context [11]. The rehabilitative process is unique in treating people according to a holistic approach or a bio-psycho-social model with the aim of supporting a person's independent living and autonomy. Rehabilitation has been demonstrated effective and efficient in reducing the burden of disability and enhancing the opportunities for disabled people. On the base of clinical, affective and functional evaluation, physiatrists have to plan the rehabilitative project including all structural body and functional areas that need of reparative and rehabilitative interventions. Rehabilitative project has to forecast time and intervention type, to individuate recoverable limitations and the functional objectives that can be reached. Furthermore, suitable rehabilitative methods and techniques have to be described in reaching the results as well as the specific role of involved personnel staff in the rehabilitative process. The role of rehabilitation intervention and how much specific strategies can affect functional recovery have to be communicated and discussed with patients and his/her family. Indeed, discussion regarding goals of care and advance care planning ought to be common place in executing rehabilitative project.

Patients and caregivers should be discouraged from setting unrealistic rehabilitation goals, whenever required functional abilities are not recoverable. The rehabilitation project should be tailored on the individual effective needs of CKD people according to the holistic approach considering stage of disease, complications and co-morbidities. As a patient-centered process, it has to be appropriate to optimize both activity and participation to ameliorate person's quality of life. People with CKD could complain of complex functional impairments and multi-system clinical disorders needing of specialized care and specific rehabilitative interventions. In this case, the rehabilitative project can be only executed by an interdisciplinary approach with a multi-professional team work that include physiatrist, geriatrician, nephrologist and other medical practitioner such as nurses, social worker, and occupational or physical therapist in order to obtain the best benefit by the one's own expert and competent contribute.

### **Chronic Kidney disease and disability**

CKD are associated with an increased risk of functional impairment, independent of age, gender, co-morbidities, and cardiovascular events [12]. The association with functional limitation has been observed not only in patients with ESRD [13] and moderate-severe CKD (mean GFR 25 ml/min/1.73 m<sup>2</sup>) [14], but also in subjects with milder CKD (mean GFR 50 ml/min/1.73 m<sup>2</sup>) [12]. Several causes can contribute to limitations occurrence in these subjects including anemia, protein-energy malnutrition, lower muscle strength, metabolic disturbances resulting in reduction exercises tolerance, independence and ability to perform activities of daily living (ADL). Because ability decline occurring in adult CKD subjects, rehabilitative strategies should be planned on the base of age, functional limitations, residual abilities, participation and co-morbidities. In CKD adult subjects with retained ADL and IADL (instrumental activity of daily living) capacities, clinicians have to recommend active life style with regular physical exercise to prevent functional decline. In subjects who present reduced abilities and more complex limitations, a multi-disciplinary approach should be carried out.

#### *Exercise training for adults with chronic kidney disease*

The ability and capacity to perform ADL (physical functioning) is severely reduced in adults with CKD [15]. Low levels of physical activity and poor physical functioning are strongly associated with mortality and poor clinical outcomes in these patients, regardless of treatment modality [16]. During the last 30 years, there have been a significantly increasing number of published studies concerning the effect of regular exercise training in adults with CKD. The first seminal step of rehabilitation intervention is based on the exercise prescription. Clinicians should counsel the patients with CKD to increase physical activity levels and inform them that there is scientific evidence that regular exercise benefits health [17]. Exercise regimens are based on the frequency, intensity and duration of exercise training as well as the type of activity and the individual's initial level of physical fitness. The training regimen should include aerobic, resistance and flexibility activities. Aerobic exercise training should build up to at least 30 min of moderate intensity exercise on 5 days per week using a gradual approach. By now, there is evidence for significant beneficial effects of regular exercise on physical fitness, walking capacity, cardiovascular dimensions (e.g. blood pressure and heart rate), health-related quality of life and some nutritional parameters in adults with CKD [15]. Physical activity has the potential to positively impact upon aerobic and functional ability, and the quality of life of all CKD patients independent of the stage of the disease process [18]. Regular exercisers have better quality of life, physical functioning, sleep quality scores, report fewer physical activity limitations and are less affected by pain or poor appetite. In models adjusted for demographics, co-morbidities and socio-economic indicators, mortality risk was 27% lower among CKD subjects performing regular exercisers compared to subjects who performed poor physical activity [19].

*Disability and Rehabilitation intervention in CKD elder subjects*

Because average levels of GFR tend to decrease with age, CKD becomes increasingly prevalent with advancing age, and nearly half of old people suffers from this condition [4]. Physical impairment can be detected in the early stages of elder CDK people [20, 21]. In elders, CKD is associated with the development of disability independent of body composition, physical performance and comorbidity [20]. In comparison with those with normal renal function, the elderly patients with CKD are more likely to have increased co-morbidities, walking impairments and decrement in quality of life. Older subjects with GFR less than 45 mL/min/1.73 m<sup>2</sup> have an odds of IADL or basic activities of daily living (BADL) decline more than threefold greater compared with those without CKD [7]. Furthermore community-dwelling older adults with CKD show an accelerate decline in life-space mobility trajectory that produces reduced ability to move to outside one's home, neighborhood, or town and to engage in social activities and participation including family events and religious services [22]. Walking impairment is fairly common in elderly CKD people and strongly associates with all-cause mortality [23]. Several rehabilitative strategies and approaches can be applied in these people to delay the functional decline and to ameliorate the residual abilities (table 1). In early stage of CKD, proper exercises have to be planned in those who have mild co-morbidities and not severe limitations. Physical activity including aerobic and resistance exercises have been recommended producing positive effects on cardio-respiratory fitness, physical function and self-reported health [24]. Moderate to high-intensity strength training improves physical performance, muscle mass and quality of life in CDK [25] as well as dialysis older patients [26]. Of course, not all CKD subjects have to perform regular exercises. In addition to that reported by American College of Cardiology Foundation/American Heart association, several contraindications are specific to CKD patients such as symptomatic hearth arrhythmias, pulmonary congestion, and peripheral oedema. On the other hand, specific rehabilitative interventions have to be tailored whenever multiple co-morbidities such as multi-joints arthritis, sarcopenia, heart failure and neurological disturbances contribute to the disability. Recently a different model has been proposed in caring elder CKD people that should change from traditional disease based model to individualized patient-centered approach [22]. An individualized approach prioritizes patient preferences and embraces the notion that observed signs and symptoms often do not reflect a single unifying disease process, and instead reflect the complex interplay between many different factors. This care method could result particularly positive in frail old people with CKD. These subjects are mostly inclined toward hospitalization, disability and death. Thus, it is crucial to develop interventions in decreasing adverse health outcomes. A large number of papers have reported that also frail elder people can benefit from regular physical activity including aerobic or endurance exercises training [27]. Among frailty factors, one of most important is loss of muscle mass. Although data remain controversial, studies have revealed that aerobic exercises can increase muscular mass of extremities in elderly [28]. The right rehabilitative interventions should be planned on the functional ability of elders and tailored by more structured and interdisciplinary approaches as functional decline advances [29]. Interdisciplinary care team including physiatrist, geriatrician, nephrologist and other medical practitioner knowledgeable in the care of older adults such as nurses, social worker, and occupational or physical therapist could be more effective than usual a single or disease-centered approach in treating multi-system disorders of frail old people with CKD. Occupational therapy can be an essential rehabilitative strategy in those suffering from CKD and multiple co-morbidities that affect functional abilities and ADLs. The use of assistive devices is a common intervention used to meet the goal of maintaining independence and assistive tools are commonly recommended for ADLs. They include dressing sticks, long handled shoe horns, long handled sponges, button hooks, shower seats, and three-in-one commodes. These items have been shown to be effective in minimizing energy output and improving function with self care and ADLs in patients with functional deficits from orthopedic and neuromuscular diseases. Correct techniques can save energy, increase time efficiency, and decrease frustration. Rehabilitative intervention can help to find the best

**Table 1.** Rehabilitative strategies in old people with CKD and ESRD

|  |  |
|--|--|
| Early stage of CKD   | physical activity including aerobic and resistance exercises producing positive effects on cardio-respiratory fitness, physical function and self-reported health  |
|  | moderate-to high-intensity strength training improves physical performance, muscle mass and quality of life  |
| Multiple co-morbidities and mild disability                  | individualized patient-centered approach: <ul style="list-style-type: none"> <li>✓ physical activity including aerobic exercises</li> <li>✓ resistance exercises</li> <li>✓ proprioceptive neuromuscular facilitation</li> <li>✓ posture and balance control</li> <li>✓ joints mobilization and spine flexibility exercises</li> <li>✓ endurance, muscle strength and muscular stretching</li> <li>✓ gait training</li> </ul>  |
| Frail CKD/ESRD elder dwelling-people                         | individualized patient-centered approach according functional limitations and residual ability; address limitations and focus on patients priority and family or care-givers participation; goals-oriented interventions and functional areas of interventions with supervised sessions; patients and family educations; <ul style="list-style-type: none"> <li>✓ physical activity including aerobic exercises</li> <li>✓ proprioceptive neuromuscular facilitation</li> <li>✓ posture and balance control</li> <li>✓ joints mobilization</li> <li>✓ muscular stretching</li> <li>✓ gait training</li> <li>✓ occupational therapy</li> <li>✓ speech and cognitive rehabilitation</li> </ul> |
| Frail CKD/ESRD people requiring hospitalization              | comprehensive multi-dimensional strategy and goal-oriented approach; discussion regarding goals of care and advance care planning ought to be common place for such patients; specialized ward and interdisciplinary care team; geriatric hemodialysis rehabilitation care   |
| CKD = chronic kidney disease; ESRD = end stage renal disease |  |

technique or equipment for particular situation and recommend when a caregiver will have to provide more assistance. A further essential role of occupational therapy is environmental and home living adaptation for elders with functional limitation who are at risk of falls that are the leading cause of injury and associated morbidity in elderly. In these subjects proper programs include home hazard assessments by trained individuals, removal or modification of identified hazards, installation of safety devices such as handrails on stairs and grab bars on bathrooms, and improvements in lighting [29]. Falls may lead to decreased mobility, hospitalization, depressive symptoms, functional decline, decreased social activity and poor quality of life [30, 31]. All older adults with and without CKD at risk of falling should be offered an exercise program incorporating balance, gait, and strength training. Since fall risk can depend on several factors, a single approach can be insufficient. To date, several trials have demonstrated that multi-component and multi-factorial interventions resulted in an approximately 30% relative risk reduction in fall rate [32].



## Hemodialytic patients ad rehabilitation

The association between ESRD and functional impairment is well established [13]. Cross-sectional reports have found that individuals with ESRD have lower physical functioning than the general population. Furthermore, ESRD subjects receiving maintenance haemodialysis (HD) have a considerably lower exercise tolerance, functional capacity, endurance and strength, and more muscle wasting and fatigue than healthy subjects or patients with less severe CKD who do not yet need renal replacement therapy [33]. Similar rehabilitative strategies delivered in CKD persons can be applied to dialysis subjects, particularly the exercise training. Individual recommendations by stage and/or treatment modality of kidney disease do not presently exist, however, the following suggestions may guide exercise prescription for the CKD/ESRD patient. Patients with peak  $\text{VO}_2$  values ( $<17.5 \text{ ml kg}^{-1} \text{ min}^{-1}$ ) may obtain the largest survival benefit from exercise training [34]. Before starting exercise therapy, patients should be evaluated to define their suitability for exercise and to tailor individualized exercise prescriptions by exercise tolerance and functional capacity tests. Same recommendations and contraindications for older adults (65 years and above) of the American College of Sports Medicine and the American Heart Association [35], can be applied to patients with HD [36]. Benefits associated with exercise training are improved peak  $\text{VO}_2$ , cardiac function, quality of life, and sympatho-adrenal activity [37]. Significant improvements in lean body mass, quadriceps muscle area, knee extension, hip abduction and flexion strength have been also reported [37]. Exercise training may be delivered in non-dialysis time, either as outpatients or at home, and also during dialysis, termed inter-dialytic exercise. Sophisticated machine such as leg press and free weights have been used to improve strength and to preserve physical function. On the other hand, simple and cheap elastic bands that can be used for resistance exercises during dialysis sessions may be an attractive alternative [38]. Doubts remain about the proper physical programs to obtain benefit, but no differences has been found between intra-dialytic versus home-based aerobic exercise training on physical function and vascular parameters in HD patients [39]. It should be emphasized that the most frail and incapacitated patients are probably those most in need of physical rehabilitation as a part of their clinical care. Although dialysis initiation is associated with a functional decline that is independent of age, gender, and prior functional status, this finding is more dramatic in old people. Sterky et al. observed that dialysis elderly subjects had 50% less functional capacity than gender- and age-matched healthy subjects [40]. Only 13% of subjects after one year of HD maintain stable functionality [13]. The accelerate functional decline that occurs in dialysis old people promote mobility impairment, falls, fractures and functional limitations predisposing HD subjects to increased health utilization and long-term institutionalization. According to data from the US Data System, 25% of patients starting dialysis are over the age of 75 years and older patients represent the fastest growing group on dialysis [41, 42]. Elderly subjects with HD share many of same co-morbidities including diabetes, coronary artery disease, heath congestive failure, multilevel arthritis, pain, neuropathy, affective disorders and cognitive impairments that produce severe functional limitation and decrement of quality of life. A step-by step approach selecting the outcome to improve [43] and more recently, a patient centered intervention rather than disease treatment has been proposed [22]. In elderly subjects with advanced CKD, providers have to be prepared to adopt an integrative, individualized oriented-patient approach. Comprehensive multi-dimensional strategy and goal-oriented intervention should be provided in ESRD older subjects presenting multiform disability and requiring hospitalization. In this way, specialized geriatric rehabilitation units with on-site dialysis have been proposed in which integrated multidisciplinary care by experts in rehabilitation, geriatric medicine, and nephrology and reciprocal continued medical education among staff can help older dialysis patients with new-onset functional decline return to their home [44, 45]. Discussion regarding goals of care and advance care planning ought to be common place for such patients. Patients and caregivers should be discouraged from setting unrealistic “rehabilitation goals,” such as attaining a level of independence that

the patient has not had for several years or reversing a permanent impairment [46]. On average, the life expectancy of HD subjects aged more than 75 years is estimated to be 2.6 to 3.2 years from the dialysis initiation [47]. Since, these patients have increased risk of early death, it is need to be determined whether patients and their families prefer more effort be directed at achieving quantity of life versus quality of life [48].

## Conclusion

The number of patients with CKD worldwide is rising markedly becoming a priority public health problem. Rehabilitation is effective and efficient in reducing the burden of disability and enhancing activities and participation for disabled people. Exercise training or comprehensive multi-dimensional strategy and goal-oriented intervention should be provided in CKD and ESRD subjects according to clinical condition and functional impairments. Since severe CKD/ESRD disabled subjects present complex dysfunction, goals and expected outcomes of treatment should be discussed with the patient and caregiver. Structured prevention programs based on reducing the risk factors for CKD and rehabilitative strategies could reduce disability occurrence and related social cost.

## Disclosure Statement

The author of this article confirm that there are no conflicts to state.

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