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editorial-office@sciformat.ca

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TAVI AS THE INITIAL STEP IN A LONG-TERM TREATMENT STRATEGY: THE DYNAMICS OF PSYCHOSOCIAL OUTCOMES, THE ROLE OF SHARED DECISION-MAKING, AND TELEMEDICAL INNOVATIONS– A NARRATIVE REVIEW

Klaudia Jurkowska *(Corresponding Author, Email: kjurkowska070@gmail.com)*
Medical University of Silesia in Katowice, Katowice, Poland
ORCID ID: 0009-0003-0205-6999

ABSTRACT

Background: Transcatheter aortic valve implantation (TAVI) has evolved from a life-saving procedure for inoperable patients into a widespread standard, increasingly encompassing younger and low-surgical-risk populations. This paradigm shift, reflected in current clinical guidelines, necessitates a renewed focus on health-related quality of life (HRQoL), cognitive function, and the return to social roles.
Aim: This study aims to evaluate the psychosocial and cognitive trajectories of both geriatric and non-geriatric patients following TAVI, and to analyze the impact of digital technologies (e-Health) on long-term postoperative care and cardiac rehabilitation.
Methods: A narrative literature review was conducted, incorporating recent cardiological guidelines and studies regarding clinical qualification, cognitive changes, and the application of telemedicine.
Results: TAVI significantly improves patients' quality of life. However, age-dependent challenges are evident: geriatric patients require routine screening for frailty and cognitive impairment, whereas younger populations experience specific psychological stress related to valve durability and the prospect of future valve-in-valve procedures. Modern wearable technologies (e.g., smartwatches) effectively facilitate remote health management and a safe return to physical activity in both groups.
Conclusion: Modern qualification for TAVI should be based on shared decision-making. Comprehensive postoperative care must extend beyond hemodynamic parameters by integrating digital health monitoring to optimize psychosocial support.

KEYWORDS

Transcatheter Aortic Valve Implantation (TAVI), Health-Related Quality of Life (HRQoL), E-Health, Telemedicine, Wearable Technology, Psychosocial Well-Being, Low-Risk Patients, Shared Decision-Making

CITATION

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1. Introduction

Aortic stenosis (AS) is the most common acquired valvular heart disease requiring intervention in developed countries, and its prevalence strongly correlates with the aging population [2, 34]. For decades, surgical aortic valve replacement (SAVR) remained the gold standard of treatment for patients with severe symptomatic aortic stenosis. However, for a substantial proportion of elderly patients burdened with multiorgan dysfunction and a high degree of frailty—defined as a general depletion of biological reserves—the risks associated with open-heart surgery and cardiopulmonary bypass were deemed unacceptably high. In practice, this disqualified these patients from surgical intervention, leaving them with a poor prognosis under conservative management [8, 22].

The introduction of transcatheter aortic valve implantation (TAVI) into clinical practice initiated a fundamental revolution in interventional cardiology [1, 23]. Initially, this innovative technology was reserved exclusively for patients at extreme or prohibitive surgical risk who were disqualified from conventional surgery [8, 27]. However, outstanding results from multicenter randomized controlled trials, alongside technological advancements in valve delivery systems, led to a gradual expansion of the eligibility criteria. Indications were subsequently extended to intermediate-risk patients [26, 31] and, in recent years—backed by groundbreaking clinical evidence—to low-risk populations [13, 15, 33]. This dynamic trend has transformed TAVI from an exclusively geriatric procedure into a viable alternative for increasingly younger and more active individuals [24, 36].

As the safety of the procedure has been established and periprocedural mortality has drastically declined, the primary criteria for therapeutic success have undergone a significant shift. Modern medicine is redefining its goals; the focus in both research and clinical practice is transitioning from mere survival rates to the optimization of health-related quality of life (HRQoL) and the preservation of neurocognitive functions [6, 12]. However, the nature of these challenges differs substantially depending on patient age. In the geriatric cohort, key objectives include alleviating heart failure symptoms, preventing vascular dementia, and restoring independence in daily functioning [7, 9]. Conversely, for younger (non-geriatric) patients, the priority is a rapid return to full professional and social activity. Concurrently, these patients face a specific psychological burden: anxiety regarding the limited biological durability of the bioprosthesis and the inevitable prospect of future valve-in-valve reinterventions [29, 37].

Achieving optimal psychosocial and clinical outcomes in such a diverse patient population requires the implementation of modern, personalized postoperative care models. The tools facilitating this objective include innovative digital health technologies (eHealth), telemedicine, and personal wearable devices, such as advanced biosensors [14, 20]. These solutions enable continuous remote patient monitoring in the home environment, facilitate safe and effective cardiac rehabilitation [38], and serve as a communication bridge that reduces feelings of isolation and anxiety following hospital discharge.

The objective of this narrative review is to comprehensively examine the current literature on transcatheter aortic valve implantation (TAVI) by bridging modern clinical qualification criteria with an analysis of patients' multidirectional psychosocial and cognitive outcomes. Additionally, this study assesses the potential and effectiveness of integrating novel digital health (eHealth) solutions into postoperative care to improve the quality of life for patients across various age demographics.

2. Methodology

To systematize the current knowledge regarding long-term quality of life, psychosocial functioning, and the impact of modern medical and technological interventions on patients following transcatheter aortic valve implantation (TAVI), a comprehensive literature review was conducted. This review encompassed medical and multidisciplinary databases, with a primary focus on PubMed. The search strategy was specifically designed to identify the most recent scientific evidence at the intersection of interventional cardiology, clinical psychology, and healthcare innovations (such as telemedicine and personal monitoring devices).

Given the dynamic advancement of minimally invasive cardiac techniques and evolving standards of postoperative care, inclusion criteria were primarily restricted to articles published within the last decade. This approach was adopted to ensure the utmost relevance and currency of the analyzed clinical and technological data. The analysis encompassed research papers including systematic reviews, meta-analyses, prospective cohort studies, the latest guidelines from scientific societies, and studies evaluating psychosocial functioning, with particular emphasis on long-term cognitive changes in patients following transcatheter aortic valve implantation (TAVI). Articles focusing exclusively on procedural technicalities or the engineering design of the valves—without a direct link to patient quality of life, long-term care, psychosocial aspects, or digital health support—were excluded from this review.

3. Results

3.1. Evolution of clinical indications: From geriatrics to low-risk populations

Initially, transcatheter aortic valve implantation (TAVI) was introduced as an innovative, life-saving therapy. It was strictly reserved for elderly patients with severe aortic stenosis in whom the risk associated with traditional surgical aortic valve replacement (SAVR) utilizing cardiopulmonary bypass was considered extremely high or prohibitive [8, 27]. In this highly selected cohort, the PARTNER 1 trial demonstrated a significant improvement in long-term survival compared to conservative management [8]. However, it must be noted that the early implementation phase of this technique was associated with a relatively high rate of complications. An increased risk of paravalvular leaks and a higher need for permanent pacemaker implantation were direct consequences of the technological limitations of early endovascular devices. The first delivery catheters were extremely bulky (with a profile of 22–24 French) and rigid, which, combined with the early stages of operator experience, amplified the risk of complications [35].

Alongside technological progress, the significant downsizing of delivery catheters and vascular sheaths—essential for the safe transfemoral tracking of the compressed valve—along with the structural optimization of both self-expanding and balloon-expandable bioprostheses, resulted in a radical reduction of vascular and hemodynamic complications [23, 35]. These breakthroughs enabled the initiation of trials evaluating the efficacy of transcatheter aortic valve implantation (TAVI) in intermediate-risk patients. Data from multicenter clinical trials, notably PARTNER 2 [16] and SURTAVI [26], clearly established that within this cohort, transcatheter intervention is non-inferior, and occasionally preferable to classic surgery in terms of overall mortality, stroke rates, and bleeding events [31].

However, the most crucial breakthrough and a complete reevaluation of treatment standards occurred with studies focusing on low-risk populations, prompting fundamental shifts in contemporary structural cardiology [24, 25]. Extensive clinical trials—spearheaded by the PARTNER 3 trial [15]—alongside registry analyses [11, 36] and long-term data from the NOTION trial [32, 33], have confirmed the high efficacy and safety of transcatheter aortic valve implantation (TAVI) in relatively young individuals without a high burden of comorbidities. Notably, the PARTNER 3 trial even demonstrated the superiority of TAVI over conventional surgical aortic valve replacement (SAVR) [15]. This success has led to an increasing number of younger, socially and professionally active patients becoming eligible for the procedure [10].

This rapid progress is directly reflected in the latest updated guidelines from both the American (ACC/AHA) [19, 22] and European (ESC/EACTS) [2, 34] cardiovascular societies. Currently, these documents unequivocally recommend transcatheter aortic valve implantation (TAVI) as the treatment of choice for older patients (typically over 75 or 80 years of age, depending on specific recommendations). Conversely, for younger patients (often defined as those under 65 years of age), surgical aortic valve replacement (SAVR) remains the preferred strategy. The 65–75 age group is considered a category with overlapping indications, where the selection of optimal therapy necessitates strict individualization [22, 34]. Scientific societies strongly emphasize the need for cautious patient selection among younger individuals, primarily due to the ongoing evaluation of the biological durability of bioprostheses (estimated at 10–15 years) [29]. Progressive structural valve deterioration (SVD) over time exposes these patients to the risk and eventual necessity of undergoing complex future valve-in-valve reinterventions, the long-term hemodynamic and clinical consequences of which remain under intense investigation [37].

Table 1. Evolution of indications and qualification criteria for TAVI.

Criterion	Traditional Model (High Risk / Geriatric)	Contemporary Strategy (Low Risk / Younger Population)
Typical patient age	> 75–80 years	< 70–75 years
Primary clinical challenges	Frailty syndrome, multimorbidity, early-stage cognitive decline.	Limited bioprosthesis durability (10–15 years), prospect of future valve-in-valve procedures.
Decision-making model	Driven primarily by surgical risk calculators (STS, EuroSCORE).	Shared decision-making (SDM) based on patient preferences and values.
Primary therapeutic goal	Reduction of dyspnea, avoidance of prohibitive open-heart surgery risks.	Rapid recovery, avoidance of sternotomy, return to sports and professional activity.

Note: Data synthesized from the weighted meta-analysis by Généreux et al. (2012) and updated clinical trials (Leon et al., 2026; Mack et al., 2019), encompassing a total of 3,519 patients across 16 studies in the high-risk cohort, contrasted with recent low-risk population registries.

3.2. Dynamics of cognitive and psychosocial outcomes following TAVI

As periprocedural mortality has declined, the definition of therapeutic success following transcatheter aortic valve implantation (TAVI) has substantially broadened. Currently, the scientific and clinical communities no longer rely solely on objective clinical parameters (such as survival rates); they place equal emphasis on the holistic assessment of health-related quality of life (HRQoL), the preservation of functional independence, and the stability of neurocognitive function [12]. However, a review of the literature clearly demonstrates that the direction and pace of these changes differ profoundly depending on the demographic and clinical profile of the patients.

In the elderly patient cohort, the primary preprocedural clinical challenge is the overlap of severe heart failure symptoms, frailty syndrome, and early cognitive deficits [7, 9]. The impact of transcatheter aortic valve implantation (TAVI) on the cognitive function of geriatric patients has been the subject of intense debate for years. On the one hand, transcatheter intervention—particularly during bioprosthesis deployment within the calcified annulus—is associated with the release of microemboli. These emboli lead to the formation of silent cerebral infarctions (SCI) visible on magnetic resonance imaging, raising concerns about accelerated cognitive decline [18]. To mitigate this risk, the efficacy of cerebral embolic protection devices is increasingly being investigated [17]. On the other hand, scientific evidence points to the opposite phenomenon: in a significant proportion of seniors, the radical relief of aortic stenosis and the restoration of normal cardiac output lead to an immediate improvement in cerebral hemodynamics. Enhanced oxygenation of neural tissue ensures that, in long-term follow-up, patients' cognitive functions not only avoid deterioration but frequently demonstrate stabilization or even measurable improvement [6, 7]. On a psychosocial level, the resolution of chronic resting dyspnea, angina pectoris, and the fear of sudden death enables older patients to break their social isolation. Regaining the ability to independently perform activities of daily living (ADL) allows them to resume family roles (e.g., as grandparents) and significantly diminishes caregiver burden [9, 12].

The dynamics of cognitive and psychological functioning unfold quite differently in younger patients qualifying for the procedure under low-risk criteria [10]. Eliminating the need for a sternotomy allows this cohort to experience rapid recovery and return to full daily activities, sports, and professional work—a process that would take many months with classical surgical aortic valve replacement (SAVR) [11]. Paradoxically, however, these patients often face a specific psychological burden not observed in the geriatric population. The awareness that the implanted bioprosthesis has limited durability and will eventually undergo structural valve deterioration generates a distinct type of chronic anxiety about the future [29]. These individuals must live with the inevitable prospect of a subsequent cardiovascular intervention in 10 to 15 years, most commonly a valve-in-valve procedure, the hemodynamic outcomes of which—especially in smaller aortic annuli—continue to pose a clinical challenge [37]. Consequently, this patient subgroup requires specialized psychological support as early as the eligibility assessment phase, as well as throughout cardiac rehabilitation programs [38].

Table 2. Variability in cognitive and psychosocial dynamics following TAVI.

Domain	Geriatric patients	Non-geriatric patients (Low-risk)
Cognitive function	Risk of silent cerebral infarctions (SCI) vs. overall improvement driven by enhanced cerebral perfusion post-stenosis resolution.	Cognitive function typically remains fully intact and stable.
Primary psychological burden	Fear of losing functional independence, falls, and progressive cognitive decline.	Chronic anxiety related to structural valve deterioration (SVD) (the "ticking clock" phenomenon).
Expected social outcomes	Overcoming social isolation, resuming active family roles (e.g., grandparenting).	Rapid return to professional activity, hobbies, and sports.
Impact on family	Significant reduction in caregiver burden.	Minimal physical caregiving required; family primarily provides emotional support.

Note: Data synthesized from the systematic review by Gargiulo et al. (2016) and prospective cohort studies (Kapadia et al., 2020; Ghanem et al., 2013), encompassing evaluations of cognitive trajectories, frailty, and health-related quality of life (HRQoL) outcomes across diverse age profiles following TAVI.

3.3. Shared decision-making (SDM) in light of current treatment standards

The progressive expansion of transcatheter aortic valve implantation (TAVI) eligibility toward younger, middle-aged, and low-surgical-risk patients has necessitated a profound evolution in the physician-patient relationship. Historically, for extreme-risk geriatric cohorts, the decision to pursue TAVI was based almost entirely on objective clinical parameters and surgical risk calculators (such as STS PROM and EuroSCORE II). In the low-risk population, however, this dynamic changes completely. Because both modalities—TAVI and surgical aortic valve replacement (SAVR)—are highly safe and effective, selecting the optimal intervention has become a strictly preference-sensitive decision [24].

In response to this paradigm shift, the latest American (ACC/AHA) [22] and European (ESC/EACTS) [34] guidelines have elevated shared decision-making (SDM) to a Class I recommendation. Under this contemporary care model, the multidisciplinary Heart Team must not confine itself solely to the technical evaluation of the patient's anatomical suitability. Its mandate is to seamlessly integrate the proposed treatment strategy with the patient's individual values, life goals, and preferences [3].

The effective clinical implementation of the SDM model requires the patient to fully comprehend the complex clinical trade-offs involved. The Heart Team must transparently outline not only the advantages of transcatheter aortic valve implantation (TAVI), but also its long-term limitations and potential complications. The established benefits of TAVI include the avoidance of a sternotomy, minimization of postoperative pain, a shorter length of hospital stay, and a rapid return to physical and professional activities. Conversely, the primary limitations of the procedure encompass the finite durability of bioprosthetic valves, a higher risk of permanent pacemaker implantation compared to surgical aortic valve replacement (SAVR), and the inevitability of future valve-in-valve interventions, which may entail significant hemodynamic challenges [24, 37].

As noted by Coylewright et al. [3], the successful implementation of the shared decision-making (SDM) model requires the medical community to undergo a period of adaptation and acquire new communication competencies, which effectively constitutes a clinical learning curve. The transition from a traditional, directive physician-patient relationship to a collaborative partnership relies heavily on the utilization of specialized patient decision aids. These tools are designed to delineate long-term risks and benefits in an accessible and comprehensible manner. The literature unequivocally demonstrates that active patient participation in treatment planning yields substantial psychosocial benefits. Patients whose preoperative expectations are appropriately calibrated within the SDM framework are less likely to experience disappointment during convalescence, demonstrate higher levels of satisfaction with their therapeutic choice, and achieve objectively superior scores on health-related quality of life (HRQoL) assessments [12].

3.4. The role of eHealth and wearable monitoring devices in postoperative care

In light of the expanding indications for transcatheter aortic valve implantation (TAVI) and the systematic shifts in the demographic profile of eligible patients, the traditional ambulatory postoperative care model frequently proves inadequate. Contemporary cardiology relies increasingly on digital medicine solutions, with innovative digital health (eHealth) technologies and telemedicine emerging as integral components of long-term clinical surveillance [20]. The deployment of these tools facilitates a seamless and safe transition from highly specialized hospital care to individualized convalescence in the home environment.

However, the implementation of digital solutions must be precisely tailored to the patient's age and technological literacy. For the geriatric population, who frequently contend with frailty syndrome and polypharmacy, telemedicine serves primarily as a pivotal tool for preventing early hospital readmissions. The remote monitoring of essential vital signs (e.g., body weight and blood pressure), automated medication reminder systems, and user-friendly fall detection devices significantly enhance patient adherence to therapeutic regimens. Furthermore, the capacity to conduct virtual consultations with members of the Heart Team facilitates the early identification of heart failure decompensation, sparing elderly patients the physical burden of in-person clinic visits [20].

The application of digital technologies assumes an entirely different dimension in younger, physically active patients classified within the low-risk cohort. In this population, wearable monitoring devices form the cornerstone of modern postoperative care. Recent research, such as the study published by Liu et al. [14], unequivocally demonstrates the high efficacy and clinical utility of advanced wearable health monitors in the remote health management of patients following transcatheter aortic valve implantation (TAVI). Equipped with photoplethysmography (PPG) technology and single-lead electrocardiogram (ECG) recording capabilities, these devices enable continuous heart rate monitoring and the early detection of cardiac arrhythmias. This is of paramount clinical importance, as complications involving new-onset conduction system blocks and episodes of atrial fibrillation remain among the greatest challenges in the post-TAVI period [14, 38].

Furthermore, these technologies provide invaluable support during cardiac rehabilitation, which has been proven to improve the prognosis of post-TAVI patients [38]. Hybrid or fully remote telerehabilitation programs leverage data from wearable devices (e.g., daily activity tracking, estimation of cardiorespiratory fitness) for the precise titration of training loads, thereby facilitating a safe return to sports and professional activity for younger individuals.

However, the benefits of implementing digital health solutions extend far beyond the mere improvement of hemodynamic parameters. Access to continuous telemedical surveillance exerts a profound, positive impact on the patient's psychological state. The awareness of being under uninterrupted digital supervision by specialists significantly alleviates anxiety regarding the functionality of the newly implanted aortic valve, mitigates stress stemming from potential false somatic alarms, and fosters a profound sense of security. Consequently, technology acts as a direct catalyst for enhancing psychosocial well-being and health-related quality of life (HRQoL) throughout the postoperative period [14].

Table 3. Application of eHealth solutions in long-term post-TAVI care.

Target Population	Primary Postoperative Challenges	Recommended Digital Technologies (Tools)	Expected Clinical and Psychosocial Outcomes
Geriatric patients	Risk of early hospital readmission, polypharmacy, difficulties in symptom self-assessment.	Simplified telecare systems, automated medication reminders, fall detection sensors.	Prolongation of functional independence, enhanced sense of security, reduced burden on outpatient clinics.
Younger / active patients	Safe titration of physical exertion, anxiety regarding bioprosthetic valve failure.	Advanced wearable biosensors (equipped with photoplethysmography and ECG), remote telerehabilitation.	Objective monitoring of exercise capacity, early detection of arrhythmias (e.g., atrial fibrillation), reduction of exertion-related anxiety.

Note: Data synthesized from the prospective technological study by Liu et al. (2022) and digital cardiology reviews (Omboni et al., 2021; Zou et al., 2023), encompassing cohorts of patients managed remotely via wearable technologies and tele-rehabilitation platforms in postoperative care.

4. Discussion

The objective of this review was to provide a multidimensional analysis of the evolution of transcatheter aortic valve implantation (TAVI)—from a life-saving procedure in geriatric patients to a therapeutic standard within the low-surgical-risk population—with particular emphasis on cognitive dynamics and the role of innovative digital health technologies in postoperative care.

The scientific evidence synthesized in this review clearly indicates that interventional cardiology has reached a historical turning point. Expanding the indications for TAVI to younger, physically active patients represents a tremendous technological triumph, enabling the avoidance of an invasive sternotomy. Nevertheless, from both a clinical and societal perspective, this success engenders new, unprecedented challenges. The utilization of bioprostheses with limited durability (estimated at 10–15 years) in patients with a long life expectancy compels the medical community to prepare for complex future valve-in-valve reinterventions. This signifies that for the younger demographic, TAVI is no longer regarded as a one-time intervention; rather, it has become merely the initial stage of a comprehensive lifetime management strategy for valvular heart disease.

A key finding of this review is that as periprocedural mortality has declined, health-related quality of life (HRQoL) and neurocognitive stability have become the central focal points for evaluating therapeutic efficacy. The synthesized data do not corroborate widespread concerns regarding a significant deterioration in cognitive function following transcatheter aortic valve implantation (TAVI) in the geriatric population. Despite the inherent risk of embolic complications, the ultimate hemodynamic balance—resulting from the restoration of normal cerebral perfusion—appears to exert a neuroprotective and stabilizing effect. From a societal perspective, restoring functional independence in seniors prevents social exclusion, significantly reduces indirect healthcare costs, and alleviates the burden on family support systems. Paradoxically, it is within the younger patient cohort that a specific psychological issue has emerged: chronic anxiety concerning premature structural valve deterioration. This phenomenon highlights a growing gap in the traditional care model; while contemporary cardiology excels at repairing the structural anatomy of the heart, it still inadequately addresses the long-term, procedure-specific psychological burden borne by the patient.

These observed shifts necessitate a fundamental restructuring of existing postoperative care pathways. For modern clinical practice, this entails moving away from a traditional, directive approach in favor of shared decision-making (SDM). The patient must become an active, informed partner in treatment planning, fully comprehending the complex clinical trade-offs inherent in the selection of TAVI.

In light of these findings, eHealth technologies and wearable monitoring devices are emerging as pivotal tools in supporting the recovery process. Their implementation serves as a direct response to the aforementioned psychosocial challenges across both age demographics. Within the older patient population, telemedicine functions as an early warning system for cardiovascular decompensation, thereby significantly prolonging their period of functional independence. Conversely, for younger patients, the utilization of mobile health tracking and telerehabilitation not only provides objective metrics of their progress toward full physical recovery but also effectively mitigates the aforementioned health-related anxiety. Continuous remote surveillance restores a profound sense of security, accelerating their return to full social and professional activities.

5. Conclusions

Transcatheter aortic valve implantation (TAVI) represents one of the most significant breakthroughs in cardiology, having evolved from a last-resort procedure for geriatric patients into a standard of care for populations at low surgical risk. This dynamic medical advancement has necessitated a reevaluation of therapeutic objectives; alongside overall survival rates, health-related quality of life (HRQoL) and the preservation of neurocognitive function have emerged as absolute priorities. The findings of this review demonstrate that postoperative care must be highly individualized, accounting for the distinct psychosocial burdens present within specific age demographics. In the oldest patient cohort, the primary focus remains on combating social isolation, mitigating frailty syndrome, and restoring functional independence. Conversely, younger patients require targeted psychological support to help them cope with the anxiety surrounding premature structural valve deterioration and inevitable future reinterventions.

In response to these challenges, the procedural qualification process must be grounded in the shared decision-making (SDM) model, ensuring that the selected therapy is fully aligned with the patient's values, professional plans, and expectations. Achieving comprehensive therapeutic success in an era of diverse patient profiles is no longer attainable without the adoption of digital medicine tools. The seamless integration of innovative digital health (eHealth) technologies and wearable monitoring devices has become an indispensable component of modern, holistic postoperative care. The deployment of telemedical systems and advanced wearable monitors not only enables the objective, remote tracking of hemodynamic parameters and optimizes cardiac rehabilitation, but, crucially, it establishes an essential digital therapeutic alliance with the patient. This profound sense of continuous medical security effectively mitigates postoperative stress, facilitating and expediting the patients' return to full familial, social, and professional activities.

Conflict of interest: The authors declare no conflict of interest.

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