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Feeling Younger, Rehabilitating Better: Reciprocal and Mediating Effects between Subjective Age and Functional Independence in Osteoporotic Fracture and Stroke Patients

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Keywords
Subjective age · Functional independence · Optimism · Life satisfaction · Self-esteem

Abstract
Introduction: The current study aimed to find reciprocal effects between subjective age and functional independence during rehabilitation from osteoporotic fractures and stroke and whether these effects can be mediated by indicators of well-being. ***Methods:*** Participants were 194 older adults (mean age = 78.32 years, SD = 7.37; 64.8% women) who were hospitalized following an osteoporotic fracture or stroke. Participants completed measures of subjective age and well-being (i.e., optimism, self-esteem, and life satisfaction) several times during rehabilitation. Functional Independence Measure (FIM) was completed by nursing personnel at admission and at discharge. ***Results:*** Younger subjective age at admission predicted higher FIM scores at discharge. The reverse effect, that is, of FIM scores at admission on subjective age at discharge, was nonsignificant. Optimism during hospitalization mediated the effect of subjective age on subsequent FIM scores while self-esteem and life satisfaction did not. Sensitivity analyses further showed that the effect of subjective age on FIM was significant for both fracture and stroke patients. ***Discussion:*** The findings highlight the effect of subjective age on rehabilitation outcomes among osteoporotic fractures and stroke patients and suggest several potential mechanisms behind this effect. Rehabilitation outcomes following osteoporotic fractures or strokes could improve if subjective age and an optimistic outlook are taken into consideration.

Introduction

Findings from an abundance of studies have indicated that subjective age – the age individuals feel [1] – is a stronger predictor of physical and psychological health

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outcomes in the second half of life compared to chronological age [2, 3]. According to those studies, a younger subjective age which is associated with a positive attitude toward one's aging [4] implies higher well-being and lower mental distress [5, 6], better physical health, and decreased mortality risk [7, 8].

Most of those studies assessed community-dwelling samples and only few examined the predictive utility of subjective age on health outcomes in clinical samples. The objective of our study was therefore to fill that gap by assessing bidirectional effects of subjective age and functional status during rehabilitation following osteoporotic fracture and stroke.

Older adults tend to reflect upon their aging and interpret it, and apparently, these reflections stem from changes in their biological, social, and psychological functioning [9]. The result of this process are older adults' subjective views of aging, which include individuals' perceptions, attitudes, or expectations of their own age and aging process, as well as of old age and older adults in general [9]. Therefore, the concept of subjective views of aging is an overarching term incorporating different constructs, including among others, ageist attitudes and subjective age.

In our research, we employed Westerhof and Wurm's model [10] which provides theoretical arguments to assume an association between subjective age and health and according to which favorable subjective views of aging contribute to the development and enhancement of psychological resources such as self-efficacy and well-being. This results in higher motivation to preserve healthy behaviors, which contribute to health and longevity.

In addition to Westerhof and Wurm's model [10], Levy's stereotype embodiment theory [11] further delineates the pathways connecting age stereotypes to health of older adults. Levy's theory proposes that age stereotypes develop early in life. Later on, age stereotypes are directed against the self. These stereotypes when embodied might affect older adults' physical and mental health through three main mechanisms. The physiological mechanisms include automatic nervous system arousal due to stressful negative stereotypes. Psychological mechanisms and behavioral mechanisms include self-efficacy, motivation, and the adoption of healthy behaviors.

Westerhof and Wurm's model [10] further provides theoretical arguments to assume bidirectional effects of subjective age and health as it includes a feedback loop through which the decline in health status may negatively affect subjective views of aging. However, the potential reciprocal effects of subjective views of aging and health were rarely explored [12]. In the context of subjective age, one study showed that a young subjective age predicted lower levels of frailty; however, the reverse effect was nonsignificant [13]. As aforementioned, this study set to study the reciprocal effects between subjective age and functional status during rehabilitation. In addition, the study aimed to highlight potential mechanisms underlying these effects. Following Westerhof and Wurm's model [10], we focused on several well-being indicators.

The current study examined three well-being indicators as possible mediators for the effects of subjective age on rehabilitation and vice versa: optimism, self-esteem, and life satisfaction. Optimism refers to individuals' tendency to expect positive outcomes [14]. Self-esteem is a personal judgment of the worthiness that is expressed by the attitudes individuals hold toward themselves [15]. Although some models do not consider self-esteem to be a component of well-being, eudemonic theories of well-being do consider components of self-esteem, such as self-acceptance, within the concept of well-being [16]. Other theorists further refer to the fact that self-esteem shares a significant amount of variance with well-being indices and therefore conclude that self-esteem is essential to well-being [17]. A younger subjective age is related to higher optimism and higher self-esteem [18], and the latter two are well-known predictors of health outcomes [19, 20]. Life satisfaction, the degree to which individuals positively evaluate the overall quality of their life as a whole, reflects the hedonic dimension of well-being. A younger subjective age is related to higher life satisfaction [21], and life satisfaction is a well-known predictor of health outcomes including longevity [22].

As noted above, our study focused on a clinical sample of older adults rehabilitating after osteoporotic fracture or stroke. Fractures and stroke are frequent health events that affect functioning [23, 24] and frequently result in the loss of one's functional independence, which is considered as the greatest fear of older adults [25, 26]. The main health outcome in this study refers to functional independence or the ability to perform daily living tasks safely and without help [27]. It is mostly assessed by the Functional Independence Measure (FIM) test [28, 29].

Based on the above, we hypothesized a reciprocal effect between subjective age and FIM scores during rehabilitation from osteoporotic fractures and stroke, namely (a) that a younger subjective age at admission to rehabilitation would predict higher FIM scores at discharge and (b) that higher FIM scores at admission would predict a younger subjective age at discharge. We also hypothesized that these reciprocal effects would be mediated by the three above mentioned well-being indices.

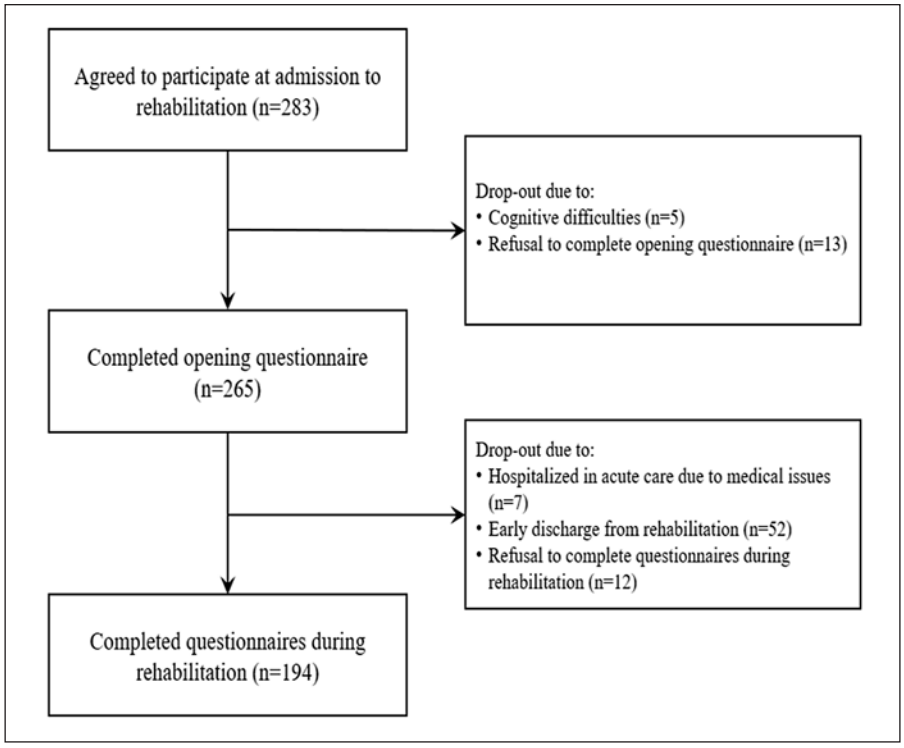

Fig. 1. Flowchart summarizing the various reasons for attrition.

Materials and Methods

Participants and Procedure

This study employed a convenience sample of older adults in three rehabilitation facilities across Israel, who were rehabilitating after hip fractures or strokes, between October 2016 and September 2019. The patients were admitted to the rehabilitation facility directly from the acute care hospital, after undergoing hip fracture surgery or a stabilizing treatment for stroke. A week after their admittance to the rehabilitation facility, the social worker or the chief nurse of the ward examined the patients' medical records and selected the patients according to the inclusion criteria of the study. The selected patients were approached and asked whether they would be willing to participate in the research after the staff explained what the research was about and what their participation would entail. Those who agreed were introduced to the research assistants. All participants (n = 283) provided a written informed consent and were interviewed face to face by research assistants.

Of the 283 participants, five dropped out due to cognitive difficulties, and 13 refused to complete the opening questionnaire. Of the remaining 265 participants, 7 dropped out because they were hospitalized, 52 participants were discharged at an early stage and did not complete the questionnaires, and 12 had second thoughts and refused to complete the questionnaires (Fig. 1).

All in all, 194 participants completed the questionnaires during rehabilitation. An institutional review board approval was obtained in all rehabilitation facilities. Inclusion criteria included being 65 years old or above, having a Hebrew proficiency, and scoring >24 on the Mini-Mental Test [30].

We ran attrition analyses that compared patients who did not complete all measures (n = 89) to those who did (n = 194). The findings indicated no significant differences in most background characteristics, subjective age at admission, and FIM at admission and at discharge. There were however significant group differences in two variables. Relative to those who did not complete all measures, those who completed all measures had a higher education level ($\chi^2(5) = 13.23$, $p = 0.02$) and were hospitalized for longer periods (log-rank $\chi^2(1) = 7.05$, $p = 0.008$).

The final sample (N = 194) had a mean age of 78.32 years (SD = 7.37), 64.8% were women, 32.2% were men, 32.1% had an academic degree, and 72.6% and 22.6% were admitted for fractures and stroke, respectively. Average number of self-reported medical conditions was 2.14 (SD = 1.23). The median hospitalization length was 29 days.

When comparing patients with stroke to those with fracture, we found few differences in background characteristics or in the main study variables. Relative to patients with stroke, patients with fracture were older, had a higher proportion of women, and had a shorter hospitalization period. The two groups did not differ in all other variables (see online suppl. file; for all online suppl. material, see www.karger.com/doi/10.1159/000524885). Although stroke and hip fractures are distinct health phenomena with probable differences in risk factors, pathophysiology, and consequent afflictions [31], patients with either condition need to cope with severe functional decline. Therefore, we chose to combine both subgroups in the main analyses while controlling for the main reason of rehabilitation (stroke vs. fracture). In addition, we performed sensitivity analyses in which we examined patients with stroke and fracture separately.

Table 1. Descriptive statistics for the study variables

	M/%	Md	Q1–Q3	SD	1	2	3	4	5	6	7	8	9	10	11	12
Subjective age admission	2.49	2.50	2.00–3.00	0.67	–											
Subjective age discharge	2.82	3.00	2.25–3.25	0.66	0.44***	–										
FIM admission	66.32	65.00	56.50–77.00	15.11	–0.08	–0.005	–									
FIM discharge	96.20	98.00	87.00–107.00	14.03	–0.26***	–0.20**	0.60***	–								
Optimism	4.01	4.33	3.00–5.12	1.46	–0.26***	–0.44***	0.07	0.21**	–							
Self-esteem	3.37	3.50	2.08–4.52	1.50	–0.25***	–0.22**	0.06	0.13	0.58***	–						
Life satisfaction	3.41	3.50	2.00–4.68	1.51	–0.24**	–0.27***	0.06	0.15*	0.67***	0.83***	–					
Age	78.32	79	73–84	7.37	0.08	0.10	–0.16*	–0.17*	–0.10	–0.10	–0.06	–				
Gender (women)	64.8	–	–	–	0.02	0.02	–0.03	0.06	–0.08	–0.04	–0.07	–0.01	–			
Education level (academic degree)	32.1	–	–	–	–0.12	–0.14	0.05	0.13	–0.03	0.07	–0.02	–0.04	0.02	–		
Medical conditions, *n*	2.14	2	1–3	1.23	0.13	–0.04	–0.16*	–0.16*	0.02	–0.10	–0.09	–0.01	–0.12	–0.10	–	
Hospitalization period, days	33.13	29	22–40	15.61	–0.03	–0.23**	–0.15*	–0.06	0.07	0.01	–0.002	–0.19**	–0.21**	0.03	0.09	–
Main reason for hospitalization (fracture)	72.6	–	–	–	0.05	0.12	0.06	0.07	–0.14	–0.02	–0.07	0.25***	0.28***	0.08	–0.08	–0.26***

N = 194. Correlation values represent Pearson coefficients except for coefficients for dichotomous variables that represent point-biserial coefficients. FIM, Functional Independence Measure.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Measures

FIM was completed by the nursing personnel who rated the patients' functioning level at admission and at discharge using the FIM test [27, 28]. FIM is an 18-item measurement tool by which nurses evaluate the physical, psychological, and social functions of patients with functional mobility impairments (e.g., eating, bladder management, transfer from bed/chair/wheelchair). Each item is rated on a scale ranging from 1 ("total assistance") to 7 ("complete independence"). The FIM score is computed as the sum of items. Therefore, the FIM scores may range from 18 to 126, with higher scores indicating a better level of independent functioning.

Subjective age was assessed by a four-item scale referring to how old one feels on the following subjective age dimensions: physical age, mental age, behavioral age, and look age [32, 33]. The items were rated on a scale ranging from 1 to 5 (1 = "feeling much younger than my age" to 5 = "feeling much older than my age"). The subjective age score was the average of scores with higher scores reflecting older subjective age. Previous studies have found the scale to be reliable and valid [34]. In the current study, subjective age at admission and at discharge showed good internal reliability (Cronbach's alpha = 0.85 and 0.84, respectively).

Well-being was assessed by three indicators referring to optimism, self-esteem, and life satisfaction. Optimism was a single item taken from the Scale Optimism-Pessimism-2 [35]. The item was: "I am looking to the future with confidence and expect good things to happen." Self-esteem was assessed with the Single-Item Self-Esteem Scale [36]. The item was: "I have high self-esteem." Life satisfaction was assessed with a single item taken from the Mental Health Continuum questionnaire – Short-Form (MHC-SF) [37]. The item of the scale was: "I am satisfied with my life." The items were rated several times across rehabilitation (mean times = 2.69, SD = 2.81) on a Likert scale (1 = "Not at all" to 6 = "All the time"). The three well-being scores (i.e., life satisfaction, self-esteem, and optimism) were computed as the mean ratings provided throughout rehabilitation. A high score signified a higher level in each of these three well-being indices. Previous studies have found these single items to be reliable and valid [35–38]. Demographic data (age, gender, education), medical conditions, and hospitalization period (in days) were collected from the patients' medical files.

Data Analysis

In order to test the study hypotheses, we performed cross-lagged analyses using AMOS 25.0 which examined the reciprocal effects of subjective age and FIM. The analyses simultaneously tested the effect of subjective age at admission on FIM at discharge, as well as the effect of FIM at admission on subjective age at discharge. The model further tested the auto-regressive effects of subjective age and FIM. Each of the three mediating variables of well-being was added to the basic cross-lagged model so that the specific contribution of each measure to the reciprocal effect of subjective age and FIM was tested. We used the bootstrap technique to determine the significance of indirect effects. We controlled for age, gender, education level, number of medical conditions, hospitalization period, and the main reason for rehabilitation. These variables were controlled for as they may affect rehabilitation outcomes [39].

Across variables with missing values, 0.5–3.1% cases were missing. Little's missing completely in a random test revealed that the data were missing completely at random, $\chi^2(113) = 126.69$, $p = 0.17$. Missing data were replaced with maximum likelihood when running models in AMOS.

Results

Table 1 presents descriptive statistics for the study variables. As can be seen, subjective age at admission was not related to FIM at admission. Moreover, a younger subjective age at admission was related to higher levels of optimism, self-esteem, and life satisfaction during rehabilitation and to a younger subjective age and higher FIM at discharge. A younger subjective age at discharge was related to higher FIM at discharge, as well as to higher well-being scores during rehabilitation. The main variables showed few significant correlations with the background characteristics (see Table 1 for more details).

The basic model (without covariates and mediators) had good fit: $\chi^2/df = 1.76$ ($\chi^2 = 3.52$, df = 2), CFI = 0.99, RMSEA = 0.06, 90% CIs (0.000, 0.17). Younger subjective age at admission predicted a higher FIM score at discharge ($B = -4.59$, $\beta = -0.22$, SE = 1.23, $p < 0.001$), whereas FIM at admission did not predict subjective age at discharge ($B = 0.001$, $\beta = 0.03$, SE = 0.003, $p = 0.71$). When adding the covariates to the basic model (without mediators), the model had good fit: $\chi^2/df = 1.71$ ($\chi^2 = 20.52$, df = 12), CFI = 0.96, RMSEA = 0.06, 90% CIs (0.000, 0.11). Again, younger subjective age at admission predicted a higher FIM score at discharge ($B = -4.59$, $\beta = -0.22$, SE = 1.23, $p < 0.001$), whereas FIM at admission did not predict subjective age at discharge ($B = 0.001$, $\beta = 0.02$, SE = 0.003, $p = 0.71$).

We further performed additional analyses in order to examine each of the subjective age dimensions separately. These analyses showed that three out of four subjective age dimensions rated at admission (i.e., physical, mental, and behavioral subjective age) predicted FIM at discharge. Look subjective age did not predict FIM at discharge (see more details in the online suppl. file).

The model that included the covariates and mediators (Fig. 2) had good fit: $\chi^2/df = 1.37$ ($\chi^2 = 41.24$, df = 30), CFI = 0.98, RMSEA = 0.04, 90% CIs (0.000, 0.08). Table 2 presents the coefficients from that model. Again, a younger subjective age at admission predicted higher FIM at discharge. Moreover, a younger subjective age at admission predicted higher optimism, self-esteem, and life satisfaction during rehabilitation. Higher optimism during rehabilitation predicted higher FIM at discharge. Self-esteem and life satisfaction during rehabilitation did not predict FIM at discharge. Additionally, we tested the possible mediation effect of optimism using Gaskin and Lim's AMOS plugin [40]. The results revealed that a younger subjective age at admission predicted higher optimism during rehabilitation, which subsequently predicted higher FIM scores at discharge ($B = -0.93$, bootstrapped 95% CIs [−2.38, −0.06], $p = 0.02$). However, no mediation effect by the three well-being indicators was found in the reverse sequential direction, that is, between FIM at admission and subjective age at discharge.

In sensitivity analyses, we examined the basic model separately for fracture ($n = 147$) and stroke patients ($n = 43$). In both groups, the effect of subjective age at admission on FIM at discharge was significant ($B = -4.33$, $\beta = -0.22$, SE = 1.32, $p = 0.001$, for fracture patients; $B = -7.43$, $\beta = -0.28$, SE = 2.90, $p = 0.01$, for stroke patients), while the reverse effect of FIM at admission on subjective age at discharge was nonsignificant. In addition, when testing the mediation model in the fracture group, the indirect effect of subjective age at admission on FIM at discharge through optimism was −0.94, bootstrapped 95% CIs (−2.35, −0.01), $p = 0.046$. Thus, patients with fracture who felt younger at admission reported higher optimism during rehabilitation, which subsequently predicted higher FIM scores at discharge. As the stroke group was much smaller in size than the fracture group, it was not possible to assess the mediation model solely with patients with stroke.

Discussion

In line with our hypotheses, we found that subjective age predicted future FIM scores. Participants who were admitted to the rehabilitation facility with a younger subjective age were discharged with better functioning as seen from their FIM scores. The findings further indicated that FIM, which is based on physical and cognitive functioning, did not predict subjective age.

Of the three well-being indicators, only optimism mediated the effect of subjective age at admission on the FIM score at discharge. In other words, older adults who felt younger than their chronological age at admission to the rehabilitation facility were more optimistic during rehabilitation and subsequently had better functioning at discharge from the rehabilitation facility. However, this study did not find evidence for the reverse mediating role of optimism: meaning, there was no evidence that higher FIM at admission predicted higher optimism during rehabilitation, which subsequently led to feeling younger at discharge.

There is evidence that optimism is a powerful predictor of physical functioning, health, and even mortality [19]. There is also evidence that optimistic people are known to have positive expectations about the future,

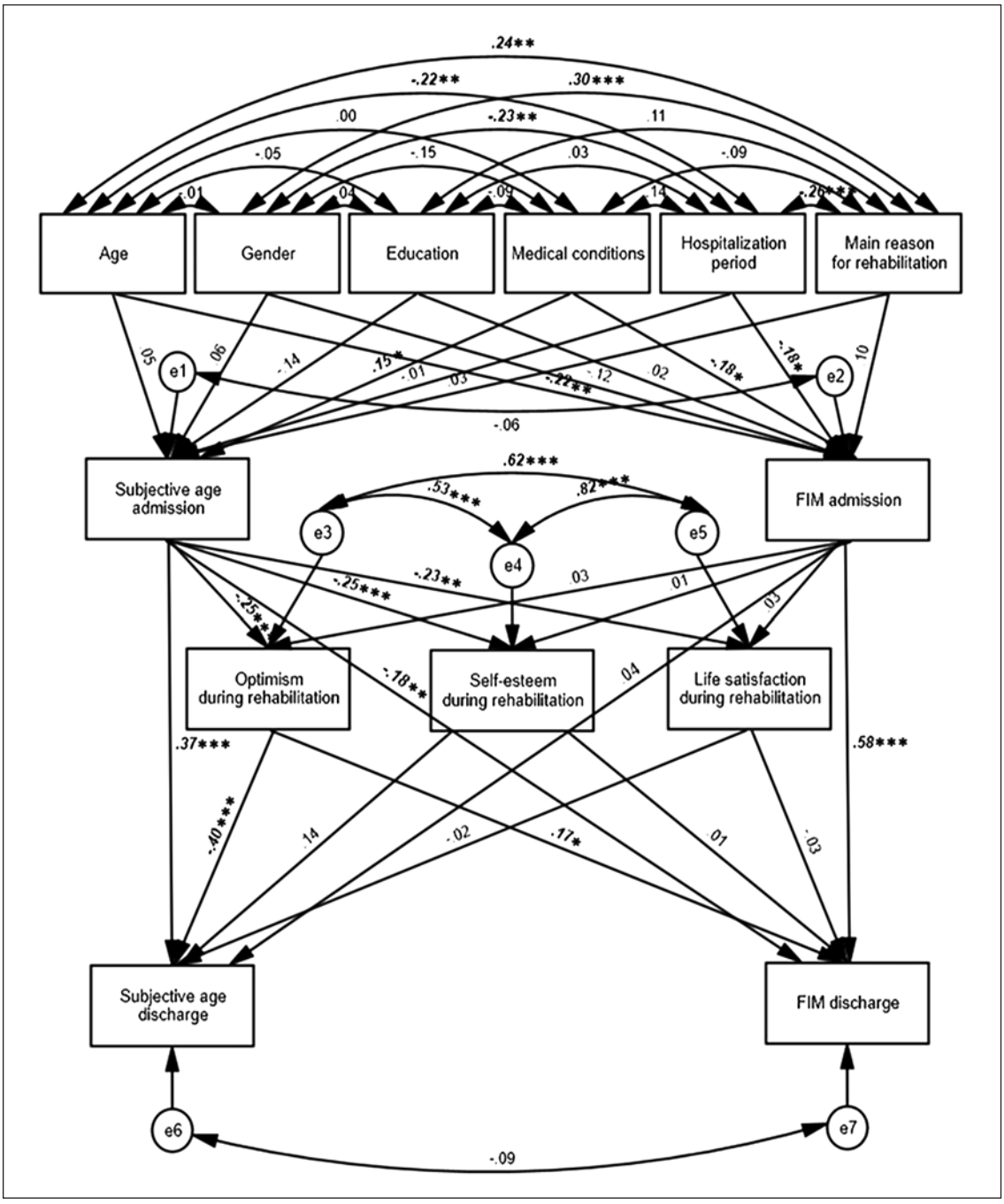

Fig. 2. The main model with mediation effects. Coefficients refer to standardized values. FIM, Functional Independence Measure. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

they enjoy better mental and physical health, they have greater social support, are more resilient, and maintain a healthy lifestyle [41, 42]. Being optimistic is pivotal for a person undergoing treatment in a rehabilitation facility as a result of a fracture or a stroke. At this stage, optimism should be the driving force that motivates the hospitalized older adult to invest time and effort in the treatment. Recent findings [43] have even indicated that optimism predicted longevity after the age of 85 years.

Table 2. Regression weights for model with mediators

Predictor	Outcome	*B*	β	SE	*p* value
Background characteristics and main variables					
Age	Subjective age admission	0.00	0.05	0.01	0.54
Age	**FIM admission**	**−0.44**	**−0.22**	**0.15**	**0.004**
Gender	Subjective age admission	0.09	0.06	0.11	0.44
Gender	FIM admission	−3.93	−0.12	2.42	0.10
Education	Subjective age admission	−0.06	−0.14	0.03	0.06
Education	FIM admission	0.17	0.02	0.78	0.82
Medical conditions	**Subjective age admission**	**0.08**	**0.15**	**0.04**	**0.04**
Medical conditions	**FIM admission**	**−2.21**	**−0.18**	**0.92**	**0.01**
Hospitalization period	Subjective age admission	−0.001	−0.01	0.003	0.86
Hospitalization period	**FIM admission**	**−0.18**	**−0.18**	**0.07**	**0.01**
Main reason for rehabilitation	Subjective age admission	0.05	0.03	0.13	0.71
Main reason for rehabilitation	FIM admission	3.67	0.10	2.85	0.20
Main variables at admission and mediators					
Subjective age admission	**Optimism**	**−0.52**	**−0.25**	**0.16**	**0.001**
FIM admission	Optimism	0.003	0.03	0.01	0.65
Subjective age admission	**Self-esteem**	**−0.53**	**−0.25**	**0.16**	**<0.001**
FIM admission	Self-esteem	0.001	0.01	0.01	0.85
Subjective age admission	**Life satisfaction**	**−0.55**	**−0.23**	**0.16**	**<0.001**
FIM admission	Life satisfaction	0.003	0.03	0.01	0.70
Auto-regressive effects for main variables					
Subjective age admission	**Subjective age discharge**	**0.37**	**0.37**	**0.06**	**<0.001**
FIM admission	**FIM discharge**	**0.54**	**0.58**	**0.05**	**<0.001**
Cross-lagged effects for main variables					
Subjective age admission	**FIM discharge**	**−3.80**	**−0.18**	**1.25**	**0.003**
FIM admission	Subjective age discharge	0.002	0.04	0.003	0.55
Mediators and main variables at discharge					
Optimism	**Subjective age discharge**	**−0.19**	**−0.40**	**0.04**	**<0.001**
Optimism	**FIM discharge**	**1.74**	**0.17**	**0.75**	**0.02**
Self-esteem	Subjective age discharge	0.06	0.14	0.05	0.22
Self-esteem	FIM discharge	0.07	0.01	0.97	0.94
Life satisfaction	Subjective age discharge	−0.01	−0.02	0.05	0.85
Life satisfaction	FIM discharge	−0.32	−0.03	1.04	0.76

Bold figures refer to significant effects. FIM, Functional Independence Measure.

Interestingly, no mediation effects were found for self-esteem and life satisfaction. Rehabilitating from stroke or fracture represents an acute health situation, and it is possible that older adults coping with such a situation are especially focused on their progress in the immediate and short-term future (embodied in optimism). Broad-scoped evaluations of self-worth or life may become prominent in the long-term when one returns to daily life after discharge.

The current findings support Westerhof and Wurm's [10] model, which describes how subjective views of aging are associated with various psychological resources, which in turn are associated with physical health and survival. Our findings also correspond with Levy's stereotype embodiment theory [11], which explains the process by which age stereotypes influence the health of older adults. Following Levy's theory [11], it is possible that older adults who internalized age stereotypes were admitted to the rehabilitation with an older subjective age. This in turn affected their optimism and motivation to invest efforts in the rehabilitation process, resulting in less favorable rehabilitation outcomes.

Our findings suggest that this could be an example of how "mind over matter," in this case subjective age, is associated with clinical health outcomes. In this regard, our findings add an additional layer to a plethora of previous

studies [1, 2] and specifically, to the relationship between subjective age and physical health [3] which emphasizes the importance of subjective age in rehabilitation.

Considering the findings, clinicians may consider applying subjective age measures when they design rehabilitation protocols. Our findings portray younger subjective age as a potential resilience factor that may motivates older individuals who experience the painful rehabilitation process after osteoporotic fracture and stroke. Since initial evidence suggests that interventions can induce a younger subjective age in community-dwelling older adults [44], further research could assist in designing interventions geared to induce a younger subjective age in patients that might assist them in rehabilitating more successfully. Such interventions may include psycho-education aimed at correcting false beliefs of aging [44], as well as cognitive techniques that help change negative automatic thoughts about aging by increasing awareness of automatic negative thoughts about aging, questioning these thoughts, and replacing them with more realistic, neutral, or positive ones [45].

Our study findings should be considered in view of the study limitations. The stroke patient group was relatively small, attrition was quite large, and well-being variables were assessed with single items. Nevertheless, our findings call to examine how various facets of subjective age predict rehabilitation outcomes. Indeed, supplementary analyses showed that most, but not all, subjective age dimensions predicted FIM at discharge. Future studies should take a closer look at the different subjective age dimensions, as well as other subjective views of aging, such as ageist attitudes, and their effect on rehabilitation outcomes.

While we could test for alternative causal directions with subjective age and FIM, this was not possible with the other variables as they were assessed during rehabilitation only. Therefore, future studies should test for the possible effects of well-being assessed prior to subjective age and functional measures. In addition, future studies should also account for additional variables that may underlie both subjective age and optimism, such as personality traits. Since rehabilitation involves time and effort spent on regaining functional independence, future studies should include these variables as potential mediators. In addition, as most of the participants were released to their homes (86.6%), reaching out and measuring the reciprocal effects between subjective age and functional outcomes several months after discharge from the rehabilitation facility would add further information about these reciprocal relationships.

In conclusion, the findings indicate that subjective age predicts functional independence mediated by optimism, meaning that subjective age at admission predicts optimism during rehabilitation, and optimism predicts higher FIM scores at discharge. Although subjective age predicts FIM at admission, FIM at admission does not predict subjective at discharge. Our findings might imply that subjective views of aging can be compared to a self-fulfilling prophecy. In this regard, it seems appropriate to end with the quote of W.I. Thomas [46]: "If men define situations as real, they are real in their consequences" (p. 193).

Statement of Ethics

Subjects have given their written informed consent. This study protocol was reviewed and approved by the Shoham Medical Center (approval No. 4.15), the Soroka Medical Center (approval No. 0330-17-SOR), and Fliman Geriatric Rehabilitation Hospital (approval No. 920170002).

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

Amit Shrira, Yuval Palgi, Noemi Heyman, Oleg Zaslavsky, and Ehud Bodner: study concept and design. Daphna Magda Kalir and Amit Shrira: acquisition, analysis, and interpretation of data; study supervision; statistical analysis; and drafting/revision of the manuscript. Carmel Batz and Aya Ben-Eliezer, Noemi Heyman, Devora Lieberman, Irena Seleznev, Inna Shugaev, and Evgeniya Zikrin: acquisition of data, study supervision, and revision of the manuscript.

Data Availability Statement

Data will be available from the corresponding author (Amit Shrira) upon reasonable request.

References

1 Kotter-Grühn D, Kornadt AE, Stephan Y. Looking beyond chronological age: current knowledge and future directions in the study of subjective age. Gerontology. 2016;62(1):86–93.
2 Alonso Debreczeni F, Bailey PE. A systematic review and meta-analysis of subjective age and the association with cognition, subjective well-being, and depression. J Gerontol B Psychol Sci Soc Sci. 2021;76(3):471–82.
3 Westerhof GJ, Miche M, Brothers AF, Barrett AE, Diehl M, Montepare JM, et al. The influence of subjective aging on health and longevity: a meta-analysis of longitudinal data. Psychol Aging. 2014;29(4):793–802.
4 Bodner E, Ayalon L, Avidor S, Palgi Y. Accelerated increase and relative decrease in subjective age and changes in attitudes toward own aging over a 4-year period: results from the Health and Retirement Study. Eur J Ageing. 2017;14:17–27.
5 Choi NG, DiNitto DM. Felt age and cognitive-affective depressive symptoms in late life. Aging Ment Health. 2014;18(7):833–7.
6 Keyes CL, Westerhof GJ. Chronological and subjective age differences in flourishing mental health and major depressive episode. Aging Ment Health. 2012;16(1):67–74.
7 Kotter-Grühn D, Kleinspehn-Ammerlahn A, Gerstorf D, Smith J. Self-perceptions of aging predict mortality and change with approaching death: 16-year longitudinal results from the Berlin Aging Study. Psychol Aging. 2009;24(3):654–67.
8 Stephan Y, Sutin AR, Terracciano A. Subjective age and mortality in three longitudinal samples. Psychosom Med. 2018;80(7):659–64.
9 Diehl M, Wahl HW, Barrett AE, Brothers AF, Miche M, Montepare JM, et al. Awareness of aging: theoretical considerations on an emerging concept. Dev Rev. 2014;34(2):93–113.
10 Westerhof GJ, Wurm S. Longitudinal research on subjective aging, health, and longevity: current evidence and new directions for research. Annu Rev Gerontol Geriatr. 2015;35(1):145–65.
11 Levy B. Stereotype embodiment: a psychosocial approach to aging. Curr Dir Psychol Sci. 2009;18(6):332–6.
12 Spuling SM, Miche M, Wurm S, Wahl HW. Exploring the causal interplay of subjective age and health dimensions in the second half of life: a cross-lagged panel analysis. Zeitschrift für Gesundheitspsychologie. 2013;21(1):5–15.
13 Li Y, Liu M, Miyawaki CE, Sun X, Hou T, Tang S, et al. Bidirectional relationship between subjective age and frailty: a prospective cohort study. BMC Geriatr. 2021;21(1):395.
14 King SP, Belkin J. Optimism/pessimism, assessment of. In: Carducci BJ, Nave CS, editors. The Wiley encyclopedia of personality and individual differences: measurement and assessment. Hoboken, NJ: Wiley; 2020. p. 231–5.
15 Coopersmith S. The antecedents of self-esteem. San Francisco, CA: Freeman; 1967.
16 Ryff CD. Psychological well-being in adult life. Curr Dir Psychol Sci. 1995;4(4):99–104.
17 Mann M, Hosman CM, Schaalma HP, De Vries NK. Self-esteem in a broad-spectrum approach for mental health promotion. Health Educ Res. 2004;19:357–72.
18 Mirucka B, Bielecka U, Kisielewska M. Positive orientation, self-esteem, and satisfaction with life in the context of subjective age in older adults. Pers Individ Dif. 2016;99:206–10.
19 Rasmussen HN, Scheier MF, Greenhouse JB. Optimism and physical health: a meta-analytic review. Ann Behav Med. 2009;37:239–56.
20 Lu H, Li X, Wang Y, Song Y, Liu J. The hippocampus underlies the association between self-esteem and physical health. Sci Rep. 2018;8:17141–6.
21 Westerhof GJ, Barrett AE. Age identity and subjective well-being: a comparison of the United States and Germany. J Gerontol B Psychol Sci Soc Sci. 2005;60:S129–36.
22 Diener E, Chan MY. Happy people live longer: subjective well-being contributes to health and longevity. Appl Psychol Health Well Being. 2011;3(1):1–43.
23 Johnell O, Kanis JA. An estimate of the worldwide prevalence and disability associated with osteoporotic fractures. Osteoporos Int. 2006;17:1726–33.
24 Johnson W, Onuma O, Owolabi M, Sachdev S. Stroke: a global response is needed. Bull World Health Organ. 2016;94:634–A.
25 Sturm JW, Donnan GM, Dewey HM, Macdonell RAL, Gilligan AK, Srikanth V, et al. Quality of life after stroke: the North East Melbourne Stroke Incidence Study (MEMESIS). Stroke. 2004;35:2340–5.
26 Zidén L, Wenestam CG, Hansson-Scherman M. A life-breaking event: early experiences of the consequences of a hip fracture for elderly people. Clin Rehabili. 2008;22:801–11.
27 Guess E, Paul D, Lane AE. Achieving functional independence. In: Braddom RL, editor. Physical medicine and rehabilitation. Philadelphia, PA: Saunders; 2011. p. 565–79.
28 Keith RA, Granger CV, Hamilton BB, Sherwin FS. The functional independence measure: a new tool for rehabilitation. Adv Clin Rehabil. 1987;1:6–18.
29 Linacre JM, Heinemann AW, Wright BD, Granger CV, Hamilton BB. The structure and stability of the Functional Independence Measure. Arch Phys Med Rehabil. 1994;75:127–32.
30 Folstein MF, Folstein SE, McHugh PR. "Mini-mental state": a practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res. 1975;12:189–98.
31 Kramer AM, Steiner JF, Schlenker RE, Eilertsen TB, Hrincevich CA, Tropea DA, et al. Outcomes and costs after hip fracture and stroke: a comparison of rehabilitation settings. JAMA. 1997;277:396–404.
32 Barak B, Schiffman LG. Cognitive age: a nonchronological age variable. Adv Consum Res. 1981;8:602–6.
33 Uotinen V, Rantanen T, Suutama T. Perceived age as a predictor of old age mortality: a 13-year prospective study. Age Ageing. 2005;34:368–72.
34 Avidor S, Benyamini Y, Solomon Z. Subjective age and health in later life: the role of posttraumatic symptoms. J Gerontol B Psychol Sci Soc Sci. 2016;71(3):415–24.
35 Kemper CJ, Beierlein C, Kovaleva A, Rammstedt B. Development and validation of an ultra-short measure for the construct of optimism-pessimism-The Scale Optimism-Pessimism-2 (SOP2). Diagnostica. 2013;59:119–29. (In German).
36 Robins RW, Hendin HM, Trzesniewski KH. Measuring global self-esteem: constructvalidation of a single-item measure and the Rosenberg Self-Esteem Scale. Pers Soc Psychol Bull. 2001;27:151–61.
37 Lamers SM, Westerhof GJ, Bohlmeijer ET, ten Klooster PM, Keyes CL. Evaluating the psychometric properties of the mental health continuum-short form (MHC-SF). J Clin Psychol. 2011;67:99–110.
38 Cheung F, Lucas RE. Assessing the validity of single-item life satisfaction measures: results from three large samples. Qual Life Res. 2014;23:2809–18.
39 Koh GC, Chen CH, Petrella R, Thind A. Rehabilitation impact indices and their independent predictors: a systematic review. BMJ Open. 2013;3:e003483.
40 Gaskin J, Lim J. Multigroup analysis, amos plugin. Gaskination's StatWiki; 2018.
41 Carver CS, Scheier MF. Dispositional optimism. Trends Cogn Sci. 2014;18:293–9.
42 Carver CS, Scheier MF, Segerstrom SC. Optimism. Clin Psychol Rev. 2010;30(7):879–89.
43 Jacobs JM, Maaravi Y, Stessman J. Optimism and longevity beyond age 85. J Gerontol A Biol Sci Med Sci. 2021;76(10):1806–13.
44 Brothers A, Diehl M. Feasibility and efficacy of the Aging Plus program: changing views on aging to increase physical activity. J Aging Phys Act. 2017;25:402–11.
45 Wolff JK, Warner LM, Ziegelmann JP, Wurm S. What do targeting positive views on ageing add to a physical activity intervention in older adults? Results from a randomised controlled trial. Psychol Health. 2014;29:915–32.
46 Merton RK. The self-fulfilling prophecy. Antioch Rev. 1953;8:193–210.