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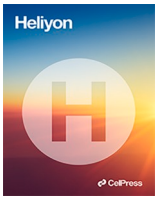

Research article

Confirmatory factor analysis of the effect of daily-living on the happiness of community-dwelling older adults in Chile

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ABSTRACT

This study examined the effect of the human-functioning dimension on happiness among community-dwelling older adults (OAs) in Chile. Questionnaires were used for data collection from a sample of 785 OAs of both sexes attending healthcare institutions. Exploratory factor analysis was performed using parallel analysis and oblique rotation. Confirmatory factor analysis and structural equation modeling were conducted using the maximum likelihood and unweighted least squares methods. Goodness-of-fit analyses were performed by considering absolute and respective incremental fit indices. The relationships between the functioning and happiness factors were all significant at the 1% level, indicating that functioning impacts happiness. The ratios of the variances between both constructs were identical to those of the covariances, indicating consistency between the models, with similarities and equalities in the estimation of their parameters. The modeling confirms a direct relationship between activities of daily living functioning and happiness. Given that a lack of functioning significantly affects OAs' happiness and quality of life, this relationship is consistent with the available theory. These findings may contribute to the formulation of social and health policies regarding OAs in Chile and other Latin American countries.

1. Introduction

Chile's current life expectancy in 2022 is 80.58 years, while the average in Latin America is 75 years, surpassing that of neighboring countries with similar or larger populations, such as Venezuela, Peru, Argentina, Colombia, Mexico, and Brazil. As a middle-developed Latin American country, Chile has a rapidly aging population, with those aged 65 years and above totaling more than 3,449,362 people, corresponding to 18% of the population. By 2035, this group is projected to reach 22% of the population. In conjunction with the social and political changes and natural disasters experienced for the past five years, these data raise a question regarding the level of well-being and happiness perceived by its inhabitants [1,2].

The concept of happiness is related to that of subjective well-being and has its origin in the perception of an emotional and cognitive state that self-evaluates each individual's present well-being [3–5]; this is complemented by vital self-satisfaction in connection with subjective well-being [6]. This may be the result of an affective balance of what is positive or negative, which may generate an overall judgment of satisfaction with each person's life in the domain of the self. Happiness types such as hedonic and eudaimonic have been

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identified, and for the purpose of this study, the latter was considered as it implies living a good life and being fully functioning [7].

Thus, like subjective well-being, happiness is a psychological component of a larger sociological concept known as quality of life (QoL) [8]. It seems evident that it is a multidimensional concept [9] that is integrative in the long term and includes objective and subjective elements self-perceived by individuals. The former refer to external contextual or environmental circumstances as well as to the characteristics that determine an individual's uniqueness [10]. The latter derive from individual perceptions that define each individual's intimate reality, allowing them to achieve the subjective well-being that gives rise to the broader concept of life satisfaction [11].

The aforementioned objective and subjective elements [12] include aspects that are relevant for older adults (Oas), such as health, home, functional ability, economic income, social life, and mental health, among others. However, each individual values their uniqueness and strives for happiness [9] as well as emotional and affective well-being that varies with age [13]. Well-being is expressed in the functional aspects of health, personal satisfaction, and happiness, determining a QoL unique to each person [14]. For this reason, OAs seek to find a balance between the subjective and objective components of QoL [14] and therefore value "feeling good" both physically, emotionally, and mentally [9,15]. The functionality of an individual's integrity during aging is a representative example, defined as a state of life caused by the interaction of biological, psychological, and social elements [16].

Human functioning and activities of daily living (ADLs) [17] represent the capacity that a person may have to perform the basic activities of daily life independently and/or autonomously [12]. This is manifested when the person is perceived as healthy and allows them to obtain higher degrees of functional adaptability with their environment, which produces personal satisfaction. Otherwise, a sufficient lack of mobility and exercise can have severe implications for self-esteem and perceived well-being, significantly affecting OAs' QoL and happiness [18].

Soberanes et al. [19] confirmed the concept of ADL functioning [17], asserting that functional impairment directly affects the perceived autonomy to control, cope, and make personal decisions about how to live according to individual preferences, reducing QoL. However, several studies [15,20] affirmed that functionality is a complex and dynamic factor of physical health that affects mental health, impacting OAs' happiness and QoL. Physical aspects are considered to be critical in determining well-being as they are linked with the maintenance of independent living [21] and are highly correlated with OAs' self-esteem and happiness [11,22].

Garatachea [14] concluded that people with greater physical functionality and awareness of their motor skills perceived higher levels of subjective well-being or happiness, although this may be affected by the environment. Additionally, the components of objective well-being [23] are critical in determining whether functional efficacy is linked not only to these capabilities but also to the structural diversity of the environment surrounding an OA [24], determining tangible aspects of objective well-being that are complemented by socioeconomic factors and living conditions [13,25]. Some conditions facilitate while others limit individuals' degrees of independence [21]; nevertheless, individuals may find themselves self-limited by subjective elements of a socio-cultural nature that have an impact when OAs' physical disabilities and psychomotor problems become evident [17].

Functionality studies in Chile based on an analysis of the basic ADLs [26] have sought to generalize these findings to the South American region. On the one hand, these aim to suggest new functional capacity-assessment methodologies and, on the other, to detect its deterioration early and monitor its stages throughout the occurrence of OAs' degrees of relative dependence [16] in their respective contexts. For example, functionality has undergone a transformational change. In the 1980s, it was understood as a linear process from disease to disability [27,28]; however, it is currently defined as a complex process through which people fluctuate between different stages of loss of functionality throughout the life cycle [27,29]. Consequently, the present study provides an alternative that allows OAS' functionality to be related to their self-perception of happiness. Such an approach, therefore, makes it feasible to examine this later in other contexts [30] of the South American region.

In the Chilean context, the health approach has also evolved. In the previous decade (2001–2020), improving OAs' QoL in the years of survival was proposed [31], whereas the current proposal (2021–2030) includes the components of functionality as among its seven central axes [32], ratifying the relevance that public-health institutions progressively ascribe to this factor.

Last, analyzing the conceptual basis of the concepts of functionality that derive from the ADLs and the components that define happiness, in this case of OAs, the need to verify the existence of a relationship between these two constructs and, in turn, if it is possible to determine the existence of some degree of incidence from the functionality on OAs' happiness emerges. Consequently, this study statistically validated the relationship and incidence between the attributes of human functioning, expressed as ADLs, and happiness of community-dwelling OAs in the central zone of Chile.

2. Methodology

The present work is quantitative, cross-sectional, and exploratory in the validation of items and constructs [33]. In addition, the factors determined according to the duly referenced theory are validated via confirmatory analysis [3,4,17]. Based on the relevant methodological options of factor analysis [34] and structural modeling [35]), we propose a relevant relationship model.

The Maule Region (Region) is located in the central zone of Chile, where rural areas and urban localities are combined [36]. The Region presents wide social and cultural diversity that intertwines Mapuche Indigenous traditions and contemporary Chilean culture. However, although there are challenges in terms of education and access to health services, a homogeneous community exists ([37]. The economy of the community is based on agriculture (the production of grapes and wines), in addition to fruits, vegetables, and cereals, as well as the forestry industry and service sector such as tourism and the state administration in its provincial capitals, respectively [38].

The sample was determined considering the administrative order of the Region, which integrates four provincial capital provinces [35]). The minimum sample criterion (n) is applied with respect to the number of items per factor (n/p) contained in the questionnaire

[3,17]. This suggests a sample of 5:1 or 10:1 participants per item ([34]), determining a minimum scope of 500 observations. The final sample was subjected to filtering via box-plot analysis to eliminate outliers or extreme values that could generate some type of inconsistency in the analyses of the dimensions under study [40].

2.1. Sample

A sample of OAs of both sexes, over 60 years of age, institutionalized in a Senior Citizen Center (CAM) located in the Region, Chile, was obtained. Proportional allocation was applied to the size of the sampled population of the 30 communes in the Region using a two-stage sampling procedure stratified by conglomerates with incidental (casual) subsampling and networks (snowball) within the conglomerate. For stratification, affixation by conglomerates was performed within each commune, and it was proportional to the size of the sampled population. The CAMs registered in the National Registry of Social Organizations of Older Adults of the National Service for the Elderly (SENAMA) were used as conglomerates. Those within each stratum were selected through simple random sampling using the function "random sample of cases" from SPSS. Consequently, each stratum was left at the intersection of the commune and conglomerate. To calculate the sample size, the maximum absolute error level expected from the results of the questionnaire was ±5% for a confidence level of 95%.

2.2. Procedure

This study was approved by the Ethics Committee of the University of Talca (No. 2013018). All participants signed an informed consent form, following the ethical principles for medical research in humans established by the Declaration of Helsinki (1964). Similarly, to ensure the application of ethical standards, the questionnaire was administered anonymously under the principle of informed consent. The researchers were blinded to the content and precedence analysis of the data to avoid bias and simultaneously safeguard identity. The respondents' information was treated in a grouped manner with absolute confidentiality.

Data regarding the socio-demographic variables of sex, age, residence (rural or urban), and education level were collected. The questionnaires were personally administered by trained interviewers to community OAs of both sexes who attended community social centers located in the central zone of Chile [35]. The average response time was anticipated to be 20–30 min. Data for this study were derived from the information obtained from those aged between 60 and 90 years. For a more representative sample, data were collected in the capitals of the four provinces in the region where the study was conducted, including rural and urban areas. For identification purposes, the provinces were labeled as Provinces I, II, III, and IV.

2.3. Measuring instruments

The Katz Index of Independence in Activities of Daily Living (Katz ADL) functioning questionnaire [17] is a functioning index adapted and modified for application in Chile. A total of six items are rated on a 4-point Likert scale, ranging from 1, "I cannot do it," to 4, "I can do it without difficulty" [3]. The Subjective Happiness Scale (SHS) presents four items measured on a 7-point Likert scale, where 1 indicates "less happy" and 7 "happier." Furthermore, considering that the scales range between 4 and 7 points, we assumed that it was feasible to overcome the non-normal behavior of the data, opting to reach a sample size greater than the 500 cases expected [39].

2.4. Statistical analysis

For data analysis and modeling, all descriptive and inferential statistical analyses were performed using SPSS version 22.0 (SPSS Inc., Chicago, IL, USA), with alpha set at $p < 0.05$. A Kolmogorov–Smirnov test was used for data distribution, and Mauchly's test explored data sphericity. Levene's test was conducted to assess the homogeneity of variance or homoscedasticity, namely, testing the null hypothesis that the population variances were equal.

2.5. Exploratory factor analysis

Using exploratory factor analysis (EFA) methodology as a reference and assuming the eventual interdependence of factors, we adopted the oblique rotation method (direct oblimin) [34,40]. To extract the factors, an analysis of polychoric variables was used, and Pearson's correlation matrix and the parallel analysis (PA) method were applied. Additionally, robust factor analysis was applied using the unweighted least squares (ULS) method, allowing us to solve eventual problems of non-normality of the data ([34]). Following Pérez and Medrano [41], we opted for communalities ($\geq$0.3) and factor loadings ($\geq$0.5) considered high to discard items with low correlation [40].

To ensure consistency, stability, and precision of the model constructs, the reliability of the instruments was analyzed through Cronbach's alpha ($\alpha \geq 0.8$). The Kaiser–Meyer–Olkin (KMO) ($\geq$0.8) test for sampling adequacy [40] and Barlett's test of sphericity ([34]) were also applied. The orientations provided by the sedimentation graphs and quantitative determination of the percentage of variance explained were analyzed to obtain a simpler, interpretable solution that was closer to reality [39].

2.6. Structural equation modeling and goodness of fit

Executing the previous steps suggested for structural equation modeling (SEM) [40], we decided to use the maximum likelihood (ML) estimation method for confirmatory factor analysis (CFA) and to ratify the latent variables of the model [34]. Goodness-of-fit (GF) analyses were performed considering the chi-square absolute-statistic-radian likelihood ratios (CMIN/DF $\leq$ 3), GF index (GFI) ($\geq$0.9), root mean squared error of approximation (RMSEA $\leq$0.05), RMSE RMR index ($\approx$0) and incremental fit, adjusted GFI (AGFI) ($\leq$0.8) [40], non-normed fit index or Tucker–Lewis index (TLI) ($\leq$0.9) ([42], and the normalized fit index (NFI $\leq$0.9) [43].

3. Results

The instruments were applied to a sample of OAs belonging to 30 municipalities in the Region, Chile. In addition, considering the criteria of the number of cases with respect to the number of items (5:1), a total sample of 785 contacts was obtained. We analyzed this sample using SPSS box-plot analysis, resulting in 740 cases ($\geq$500) validated for analysis. Most participants belonged to the rural sector (50.1%), with the greatest concentration in the provincial capitals of the Region (35.1%), Province I (13%), Province II (6.5%), Province II (6.2%), and Province IV (6.1%). Their level of basic education was 34.94%, and their ages ranged from 60 to 95 years, with the majority between 71 and 74 years (12.9%), followed by those between 67 and 70 years (11%), most of whom were women (68.5%).

3.1. Exploratory factor analysis

We verified the items, factors, reliability, adequacy, and significance of the model by analyzing the ADL functioning [17] and happiness (SHS) questionnaires ([34]). In the matrix-adequacy tests, a determinant of 0.0135947 was obtained, and Bartlett's statistic = 3158.4 (df = 45; P = 0.000010), indicating the consistency of the sample for factor analysis [40].

In the joint analysis of the instruments, a KMO of 0.8 was obtained, which is considered good according to the valuation criterion proposed by Kaiser [40]. Independently, the functionality instrument obtained a KMO score of 0.82, also rated good, and finally, the happiness construct reached a KMO score of 0.72, considered acceptable ($\geq$0.7). The latent variables (factors) validated by factor loadings ($\geq$0.5) and communality indices ($\geq$0.3) in both instruments ([34]) are presented in Table 1; items with low factor loadings were disregarded [40]. Consequently, three of the four items for the happiness questionnaire were validated, eliminating item SHS04. The number of components for the functionality questionnaire remained the same, and although the variable KATZ01 presented low communality ($\leq$0.3), it nevertheless achieved a high factor loading ($\geq$0.5).

Consistent with the above, to confirm the convergence of the variables with their respective factors and to ensure that the construct adequately measured what it proposed to do [44], it was necessary to confirm that the number of variables was not less than three. In addition, to ensure the reliability of the proposed model, it was important that the factor loading and communality values are not less than 0.6 and 0.5, respectively [45]. Considering methodological suggestions [46], some RMSEA estimators were determined, and a value of 0.043 was obtained. This latter value was confirmed by the expected mean index for an acceptable model (RMSR), which equaled 0.0368, and a weighted mean square residual (WRMR) of only 0.0293. All values lower than the acceptance limit ($\leq$0.05)

Table 1
Matrix of rotated components of the exploratory factor analysis.

VAR.	ITEMS	F 1	F 2	COMMONALITY
SHS01	In general, you see yourself as being …		0.818	0.664
SHS02	Compared to most of your peers, do you consider yourself … ?		0.773	0.604
SHS03	Some people are very happy. They enjoy life despite what happens to them, taking advantage of almost everything. To what extent does this characteristic describe you?		0.752	0.566
SHS04	Some people are not very happy, although they are not depressed; they never seem as happy as they could be. How well does this characteristic describe you?	–	–	0.168
KATZ01	Feeding	0.515		0.257
KATZ02	Dressing	0.705		0.489
KATZ03	Transferring	0.843		0.710
KATZ04	Bathing	0.757		0.581
KATZ05	Continence	0.774		0,600
Explained Variance Based On Eigenvalues		3.769	2.301	
Cumulative		3.769	6.07	
Real-data % of Variance		0.42	0.25	
Cumulative		0.42	0.67	
Cronbach's α		0.867	0.826	0.808

Root Mean Square Error of Approximation (RMSEA)	0.043	Expected mean value of RMSR for an acceptable model	0.0368
Comparative Fit Index (CFI)	0.992	Non-Normed Fit Index (NNFI; Tucker & Lewis)	0.986
Adjusted Goodness of Fit Index (AGFI)	0.987	Weighted Root Mean Square Residual (WRMR)	0.0293
Inter-factors correlation matrix (F1 – F2)	0.182*	Bentler's simplicity index (S)	0.919

Note: KATZ = variables of the Activity Independence Index; SHS = variables of the Subjective Happiness Scale.

confirmed the consistency of the results and, therefore, their convergence. Additionally, the GF estimators of the factorial modeling also reached high indices, with CFI = 0.992, NNFI = 0.986, and AGFI = 0.987, all above the minimum required (≥0.90), as shown in Table 1.

To verify that the factors consistently grouped their respective variables and simultaneously constituted discriminating factors among themselves, the index of the interfactor correlation matrix (F1 – F2) was determined. A value of 0.182* was obtained, which is defined as low (≤0.30) although significant. Additionally, the Bentler simplicity index (S) was determined to be 0.919, through which the factorial modeling was confirmed, once again, in accordance with the criteria of required convergence and divergence between the determined factors.

Generally, the instrument obtained a total explained variance of 67%, where the functionality item explained 42% and the happiness item explained 25%, both of which are significant [34]. Additionally, the reliability index for the model obtained Cronbach's α of 0.808, confirming the consistency of the items analyzed. Independently, the functionality instrument obtained Cronbach's α of 0.867 and the happiness instrument an α of 0.826; consequently, both indices ratify the accuracy of the constructs analyzed, and satisfactory GFIs were obtained [40]. The RMSEA index = 0.043 (≤0.05), CFI = 0.992, GFI = 0.992, AGFI = 0.987, non-normed fit index (NNFI; Tucker & Lewis) = 0.986, all higher than the required standard (≥0.90). Last, the estimated non-centrality parameter (NCP) index = 48.035, which was lower than the required limit (≤70). The joint instrument for happiness [3] and functionality [17] was subjected to factor analysis based on the perceptions of a sample of 740 adults. OAs belonging to 30 municipalities in the Region, Chile (68.5% women, 50.1% rural representation) provided significant estimators that allowed us to confirm that the instrument questions were relevant to measure functionality and happiness in the context of the study.

Additionally, the reliability index for the model as a whole (0.808) indicates an acceptable consistency of the elements analyzed [33]. This is further confirmed by the individual indices of the functionality (α = 0.867) and happiness (α = 0.826) constructs and, consequently, allowed us to assume that it accurately collects the perceptions [34]. The sample of OAs was concentrated in the four provincial capitals of the Region (35.1%), followed by Province I (13%), Province II (6.5%), Province II (6.2%), and Province IV (6.1%), accounting for 66.9% of the total sample. Therefore, given the internal consistency determined by Cronbach's α, this provided a first approximation of the statistical validation of the scales of the construct [41].

Finally, the data were collected from a diverse sample of OAs. For example, in terms of level of education, 34.94% stated that they had completed basic education. In terms of age, the participants were between 60 and 95 years old, and most were between 71 and 74 years (12.9%), followed by those between 67 and 70 years old (11%), totaling 23.9% of the total sample. In this context, the GF estimators for the sample as a whole, such as CFI, GFI, AGFI, and NNFI, registered values higher than the required standards (≥0.90), while the RMSEA was less than the maximum acceptable (≤0.50), which indicates a good model fit.

3.2. *Variable specification and modeling*

Exogenous latent variables were defined as those belonging to the functioning and ADL factors [17] and endogenous latent variables as those belonging to the happiness construct (SHS) [3]. The model values were determined by applying the ML method to adjust the constructs under analysis [40], as it was possible to obtain the fit tests and standard errors of the parameters [34]. Furthermore, to ensure the structural modeling was as accurate as possible, ULS was additionally applied, which allowed confirmation of the model outputs, considering the eventual non-normality of the data.

SEM was performed based on covariance options to determine the existence of a relationship between the variables and based on the variance method to determine the level and direction of the relationship between the dimensions of the model. This made it possible to determine the causality relationships among the exogenous variables of Katz's ADL functioning and the endogenous variables of the SHS happiness construct (Fig. 1). As can be seen, it was possible to synthesize the variance and covariance models as a

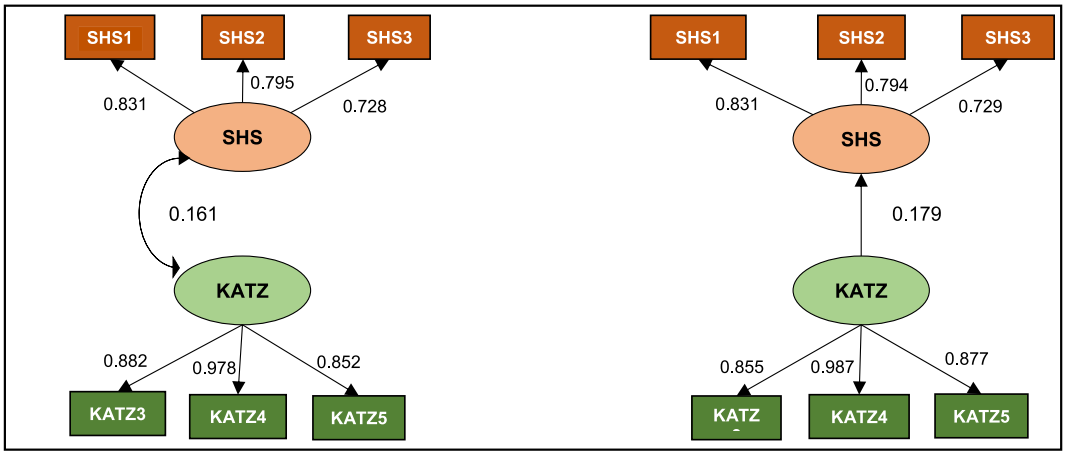

Fig. 1. Structural measurement and causal model for the factors of ADL functioning (KATZ) and happiness (SHS).

result of eliminating the variables that did not reach the required factor loadings and communalities. As illustrated in Fig. 1, the relationship indices obtained using covariance and variance reached estimators of 0.161 and 0.179, indicating that the relationship model was adequately specified. The results of the analysis of the latent variables through variance, reported in Table 2, allowed us to test the hypothesis regarding the effect of functioning on happiness in OAs. The results indicated that the relationships between the functioning and happiness factors were all significant at the 1% level (***), yielding standardized values between zero and one. Consequently, when testing hypothesis *H1: Functioning dimensions directly affect happiness*, modeling through variances confirmed an impact of the functionality dimension on the happiness dimension (0.179***). Additionally, it was verified that the covariance and variance modeling allowed confirming the estimators of the variables with their respective factors, whose estimators ranged from 0.824 for the SHS1 variable to 0.672 for the KATZ5 variable. Additionally, it was verified that the estimators determined by the covariance and variance methods reach high factor-loading indices, confirming the consistency of the relationship and incidence model between the variables of the KAST model (3, 4, 5) and the SHS model (1,2,3).

In addition, the results revealed that the level of functionality, that is, the ability of OAs to perform ADLs, was directly related to their self-perceived happiness. Some studies refer to this as successful aging. For example, a study in Chile [42] established that those who actively participated in society aged successfully and reported autonomy and independence and, through these, higher degrees of self-perceived happiness. Regarding sex, other studies document that men are less happy than women, especially those with low education, widowers, and those with little social participation, consistent with the finding that OAs' happiness comes from the opportunity they have to satisfy their respective needs [47] and that they can perform ADLs with autonomy and independence; that is, they can continue with their role as providers and integrate groups into their respective social contexts [16].

Regarding the relationship model, a standardized covariance SHS <–> KATZ of 0.161 was observed similar to the standard variance estimator SHS < – KATZ of 0.179, thus confirming the congruence between the proposed covariance and variance models.

The details of the estimators of the observed variables are presented in Table 2. These confirm the internal consistency of each construct and provide the basis for the structural modeling. Complementarily. the model is expressed by the following linear equation (1):

$$Y_n = \beta_1 X_i + \beta_2 \tag{1}$$

Where:

Y_n: Observed variable.

β_1: Standard parameter.

X_i: Factors of the observed variables to be studied.

β_2: Error of the observable variable.

According to Table 2 the parameter ranges fluctuate between 0 and 1 for the standardized parameters. indicating that the adjustments made by the ML method are optimal at a significance level of 1% for all the observed variables. Consequently. the model's constructs and its three observed variables are confirmed and ratified. suggesting that the parameters are consistent and persistent and, therefore. adequate and statistically significant.

A similar study was conducted in the Mexican context. in which an index of OAs' satisfaction with life was validated from a previous factorial study and was based on statistical estimators of a similar nature [48]. The conclusions suggest conducting equivalent studies in Spanish-speaking countries. and the current study achieves this from the perspective of functionality and its incidence in terms of OAs' happiness. In addition, although based on small samples in Colombia. studies on the concept of happiness indicate that while older women highlight family support. men value being independent and functional in their respective contexts. Regardless of their living conditions. the participants feel satisfied with their personal achievements and lives [47]. Similarly, a study in the Spanish context explored the happiness of people aged 65 years and over [50] in relation to the practice of physical activity at some points in the life cycle [51]. A comparison with our results confirms some results. For example, how physical activity affects happiness and the need to intervene in this segment [52] to promote active aging [53] and OAs' functionality.

Table 2
Parameters of the adjusted covariances and variances model.

	ML		
	Weight of logistic regression β_1	Variance β_2	Standard Value
SHS01 ←SHS	1.000[a]	0.416[a]	0.831
SHS02 ← SHS	1.000[a]	0.543[a]	0.794
SHS03 ← SHS	1.000[a]	0.820[a]	0.729
KATZ05 ← KATZ	1.000[a]	0.030[a]	0.877
KATZ04 ← KATZ	1.000[a]	0.067[a]	0.987
KATZ03 ← KATZ	1.000[a]	0.037[a]	0.855

	Adjusted Covariance Model			Adjusted Variance Model		
	Weight of logistic regression β_1		Variance β_2		Weight of logistic regression β_1	Variance β_2
Covariance SHS <–> KATZ rowhead	0.050[a]		−0.928[a]	Variance SHS ← KATZ	0.540[a]	0.899[a]
Correlation SHS <–> KATZ rowhead	0.161[a]			Variance Std. SHS ← KATZ	0.178[a]	

[a] = 0.001 Significance.

3.3. Structural modeling

Synthesizing the proposed model, Table 2 provides the non-standardized estimators that validate the hypothesis and that allow defining the structural equation proposed in the expressed formula (1) and which is detailed with the values below in formula (2).

$$SHS = 0.540\ \ KATZ - 0.899 \tag{2}$$

The estimator that accompanies the independent variable indicates that by improving the functionality of OAs by one unit, happiness improves as an index by 0.540, indicating a direct relationship.

3.4. Goodness of fit of the model

The adjusted likelihood ratio (CMIN/DF) obtained by the ML method is 1.722, which is considered excellent (≤3). Table 3 presents the various ratifying indices of the study. Additionally, the indices detailed NFI, TLI, CFI, among others, reach high values above the minimum required (≥0.9) and are confirmed by the RMSEA estimator, which measures the sum of the errors, reaching an index 0.031 below the maximum allowed (≤0.05) and is also considered excellent. Consequently, the model is representative of the reality analyzed allows us to confirm the hypothesis that functionality has a direct impact on the happiness of OAs.

4. Discussion

From the analyses. the items of the functioning construct of the Katz ADL questionnaire [17] reached an explained variance that exceeded 40%. and the happiness dimension of the SHS [3] reached an explained variance of 25%. confirming that the structure of the observable items that constitute the latent variables of the functioning-happiness construct is consistent [33,39]. In summary. the joint explained variance of 65% demonstrates that these two interrelated domains confirm the predicted theoretical relationships [19] with verified statistics [22]. Consequently. the adequacy of the model items and latent dimensions were confirmed. indicating that all parameters were persistent. adequate. and statistically significant [34,40]. Similarly, in OAs' perception. the functionality items directly and significantly affect happiness in its various dimensions [14]. and it is also confirmed that the objective and tangible dimensions of functionality affect happiness [10]. Furthermore. OAs tend to find themselves in a balanced position between the subjective and objective aspects of their lives [9]. This is confirmed by the expression "feeling good." implying that OAs value this balance and it is typical of their lives [14]. This is because. first. they reflect a positive self-perception between physical. emotional. and mental perceptions [15]. Second. the relationships between the ADL functioning and happiness factors are all significant (1%). providing relevant. standardized values that fall in the appropriate range (0 and 1) [40,42,43]. which in turn confirms that the proposed model is adequate [34,41].

When testing hypothesis H1. modeling through variances [39] revealed a direct relationship between the items of functionality and happiness SHS ← KATZ = 0.540 minus a margin of error of 0.899. The indices support this fact; that is. an increase in the positive perception of OAs' functioning directly affects the dimension of happiness. which confirms that the dimensions behave consistently and reach similarities and equalities in the estimation confirmed by the relationship parameter [8. 40. 43].

Happiness depends on various dimensions that affect functionality crucial for OAs. such as health. available functional skills. family economic income. social life. and mental health. all of which individually and jointly affect each person's well-being [12]. This is expressed in the global judgment that each OA makes regarding satisfaction with life [49] and in people's perception of their own vital uniqueness [14] owing to the positive and direct effect of functioning ADL on happiness [4,54].

The results robustly confirm the proposed model. A correlational study conducted in 2016 in Huechuraba. Metropolitan Region. Chile [55] on a small sample of 60 OAs determined a relationship between the dimensions of functionality [56]. level of self-valence. psychological health. interpersonal relationships. and environment [57]. which contribute to family functionality [55] and OAs' self-valence. In this respect. OAs' happiness involves motor aspects. these being fundamental to the perception of ADL functioning [16,19,58]. This provides autonomy and produces personal satisfaction. indicating that a loss of autonomy and independence can have severe implications for self-esteem and perceived well-being [6]. decreasing OAs' cognitive and emotional levels of perception of

Table 3
Estimator of the happiness parameter by ML and goodness of fit.

	REGRESSION WEIGHT		ε_n
SHS ← KATZ	0.540	eSHS	0.899
Goodness of Fit for Covariance and Variance Models (ML)			
CMIN/DF	1.722	RMSEA	0.031
CMIN	17.224	LO 90	0.000
DF	10	HI 90	0.056
NFI	0.991	NCP	7.224
TLI (NNFI)	0.994	LO 90	0.000
CFI	0.996	HI 90	22.825

CMIN = Chi-square of degree of freedom; GFI = goodness of fit index; CFI = comparative fit index; RMSEA = root mean square error of approximation index; non-normed fit index (NNFI; Tucker & Lewis) = 0.986. All values obtained were higher than the required standard (≥0.90). NCP = estimated non-centrality parameter index.

welfare [11].

The findings of the modeling confirm [34. 40] a direct relationship between ADL functioning and happiness [18]. In addition, this relationship is consistent with the available theory because a lack of body functioning can have severe implications for self-esteem and perceived well-being [49]. significantly affecting OAs' QoL [9]. global well-being. and. therefore. happiness [4,10,59].

4.1. Study limitations

This study has some limitations that must be acknowledged. First. although the relationships established between the variables of ADL functioning and the dimensions of happiness in the Katz model do not necessarily imply causality. we cannot confirm that one variable is the direct cause of the other. There could be unknown or uncontrolled factors influencing both variables. making it difficult to establish a causal relationship. However, regarding the generalization of the findings. given the study sample. we cannot confirm that they may be applicable to other populations of OAs or other contexts. In addition, although the quantitative approach is useful for identifying relationships between linked variables. it may not necessarily be capable of capturing the complexity and nuances of the relationship between functionality and happiness among the study subjects. Consequently. future research can adopt a qualitative approach to provide a deeper understanding of these variables and the relationship among them.

5. Conclusions

The constructs of the ADLs and happiness adequately confirmed their respective observed variables and determined statistically significant parameters. Consequently. the items behaved consistently relative to their respective latent variables and confirmed the proposed model. Therefore. given that this was a cross-sectional study. a longitudinal study aimed at analyzing how OAs' happiness and functionality scores change. how they evolve over time. and whether there are significant common or differential patterns between the capital provinces in the sample is suggested. Next, specific socio-cultural studies on the dimensions of functionality and happiness in the main provinces including variables such as traditions, values, and family structure could be implemented to guide more effective interventions adapted to each context. Generally, it would be possible to guide public policy and evaluate the effectiveness of health and social intervention programs for OAs adjusted ex-ante to local particularities.

The domains of ADL functioning and happiness show internal consistency. confirmed by identical variance-covariance indicators. confirming that the resulting model is relevant. Additionally, as a complement. and from the perspective of health-related QoL. provinces should be separately analyzed. including variables such as the impact of loneliness and family and social support on happiness. because these factors can play a significant role in the well-being of OAs in different localities and would guide future social-support interventions.

Similarly, the global study of the sample confirms that OAs' happiness depends on the perception of functioning. autonomy. and personal satisfaction. while loss of autonomy and independence decreases the cognitive and emotional levels of happiness. However, the results suggest conducting deeper comparative analyses between provinces. which would shed light on the differences and similarities in the components of happiness and functionality with respect to cultural and geographical conditions. The factorial modeling presents clear evidence that the constructs of functionality and happiness collect the perceptions of reality. Additionally, the analysis of covariance confirms the existence of a relationship between ADL and the components of happiness. Moreover. the analysis of variance confirms the influence of the dimension of functionality on that of happiness. Furthermore. the GF indices support these findings as estimators confirm that ADL does indeed affect the components of happiness. Finally, the modeling confirms a direct relationship between functionality and happiness. Notably. a lack of the former significantly affects the latter in OAs. and this relationship is consistent with the available theory.

Data availability statement

Data is available at https://drive.google.com/drive/folders/1XCfCumXZxir_PdzQOt238-ScD-qJ-1e3?usp=sharing upon request to authors.

CRediT authorship contribution statement

Miguel A. Bustamante U: Supervision, Methodology, Investigation, Formal analysis, Conceptualization. **Exequiel Plaza:** Writing – review & editing, Writing – original draft, Supervision, Methodology. **Viviana Garcia:** Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] I.N.E. Estimaciones, y proyecciones de la población de Chile 2002–2035. Totales regionales, población urbana y rural, Instituto Nacional de Estadísticas de Chile, 2019. Available in: https://www.ine.cl.

[2] Senama, Envejecimiento en Chile: Diagnóstico y Consulta Ciudadana, 2022. Available in: https://www.senama.gob.cl.
[3] S. Lyubomirsky, H.S. y Lepper, A measure of subjective happiness: Preliminary reliability and construct validation, Soc. Indicat. Res. 46 (1999) 137–155.
[4] S. Lyubomirsky, Cience of Happiness, third ed., Urano Pub Incorporated, 2021.
[5] G. Prati, Correlates of quality of life, happiness and life satisfaction among European adults older than 50 years: a machine-learning approach, Arch. Gerontol. Geriatr. 103 (2022) 104791.
[6] A.I. Tavares, Health and life satisfaction factors of Portuguese older adults, Arch. Gerontol. Geriatr. 99 (2022) 104600.
[7] Yela Crego, Ozores-Pérez, Riesco-Matías, M. Gomez-Martinez, Eudaimonic and uncertainty metaphors about life are associated with meaningfulness, experiential avoidance, mental health and happiness, J. Happiness Stud. 23 (2022) 4119–4146.
[8] D.E. Moyano, M.E. Flores, H. y Soromaa, Fiabilidad y validez de constructo del test munsh para medir felicidad, en población de adultos mayores chilenos, Universitas Psychologica 10 (2) (2011) 567–580.
[9] R. Cummins, J. y Cahill, Avances en la Comprensión de la Calidad de Vida Subjetiva, Intervención psicosocial 9 (2) (2020) 185–198.
[10] B.M. Luchesi, N.A. de Oliveira, D. de Morais, R.M. de Paula Pessoa, S.C.I. Pavarini, M.H.N. Chagas, Factors associated with happiness in the elderly persons living in the community, Arch. Gerontol. Geriatr. 74 (2018) 83–87.
[11] E. Colucci, S. Nadeau, J. Higgins, et al., COVID-19 lockdowns' effects on the quality of life, perceived health and well-being of healthy elderly individuals: a longitudinal comparison of pre-lockdown and lockdown states of well-being, Arch. Gerontol. Geriatr. 99 (2022) 104606.
[12] R. Usher, T. Stapleton, Assessing older adults' decision-making capacity for independent living: practice tensions and complexities, J. Appl. Gerontol. : the official journal of the Southern Gerontological Society 41 (5) (2022) 1264–1273.
[13] M.I. Broese van Groenou, D.J. Deeg, B.W. Penninx, Income differentials in functional disability in old age: relative risks of onset, recovery, decline, attrition and mortality, Aging Clin. Exp. Res. 15 (2003) 174–183, 2003.
[14] N. Garatachea, O. Molinero, M. Martínez-García, R. Jiménez-Jiménez, J. González-Gallego, S. Márquez, Feeling of well-being in elderly people: relationship to physical activity and physical funtion, Institute of Biomedicine and Department of Physical Education, University of León, Spain, Archives of Gerontology ang Geriatrics 48 (2009) 306–312.
[15] K.R. Fox, A. Stathi, J. McKenna, M.G. Davis, Physical activity and mental well-being in older people participating in the Better Aging Project, European, J. Appl. Physiol. 100 (2007) 591–602.
[16] N. Sakuma, H. Inagaki, M. Ogawa, A. Edahiro, C. Ura, M. Sugiyama, et al., Cognitive function, daily function and physical and mental health in older adults: a comparison of venue and home-visit community surveys in Metropolitan Tokyo, Arch. Gerontol. Geriatr. 100 (2022) 104617.
[17] S. Katz, A.B. Ford, R.W. Moskowitz, B.A. Jackson, M.W. Jaffe, Studies of illness in the age: the index of ADL a standarized measure of biological and psycososcial function, JAMA 185 (1963) 914–919.
[18] J.P. Maher, D.E. Conroy, Daily life satisfaction in older adults as a function of (In)Activity, J. Gerontol. B Psychol. Sci. Soc. Sci. 72 (4) (2017) 593–602.
[19] F.S. Soberanes, P.A.A. González, C.Y.C. Moreno, Funcionalidad en adultos mayores y su calidad de vida, Revista Española de Medicina Quirurgica 14 (4) (2009) 161–172.
[20] D.L. Gill, K. Williams, L. William, B.D. Butki, B.J. Kim, Physical activity and psychological well-being in older women, Wom. Health Issues 17 (1997) 3–9.
[21] J.S. Frank, A.E. Patla, Balance and mobility challenges in older adults: implications for preserving community mobility, Am. J. Prev. Med. 25 (2003) 157–163, 2003.
[22] P. Lampinen, R.L. Heikkinen, Gender differences in depressive symptoms and self-esteem in different physical activity categories among older adults, Women Sport, Phys. Act. J. 11 (2002) 171–197.
[23] D. Borsboom, G.J. Mellenbergh, J. y Van Heerden, The theoretical status of latent variables, Psychol. Rev. 110 (2) (2003) 203, 2003.
[24] C. Pascual, E. Regidor, J.L. Gutiérrez-Fisac, D. Martínez, M.E. Calle, V. Domínguez, Material well-being of the province of residence and leisure-time physical inactivity, Gac. Sanit. 19 (2005) 424–432.
[25] A. Koster, H. Bosma, M.I. Broese van Groenou, G.I. Kempen, B.W. Penninx, J.T. Van Eijk, D.J. Deeg, Explanations of socioeconomic differences in changes in physical function in older adults: results from the Longitudinal Aging Study Amsterdam, BMC Publ. Health 6 (2006) 244.
[26] A. Echeverría, C. Astorga, C. Fernández, P. Salgado M y Villalobos Dintrans, Funcionalidad y personas mayores: ¿dónde estamos y hacia dónde ir? Rev. Panam. Salud Públic 46 (2022) e34, https://doi.org/10.26633/RPSP.2022.34.
[27] World Health Organization, World Report on Ageing and Health, WHO, Ginebra, 2015.
[28] S.Z. Nagi, Some conceptual issues in disability and rehabilitation (1965) [citado el 10 de septiembre de 2021]. Available in: https://www.semanticscholar.org/paper/d11da5eb6d14186e8f30aa7e0d5442499bd17a8e.
[29] I. Madero-Cabib, P. Villalobos Dintrans, J. Browne Salas, Extending the analysis of functional ability trajectories to unexplored National contexts: the case of Chile, J. Gerontol. B Psychol. Sci. Soc. Sci. (2021) gbab116, https://doi.org/10.1093/geronb/gbab116.
[30] K. Hernández, V. Neumann, Análisis de instrumento para evaluación del desempeño en actividades de la vida diaria instrumentales Lawton y Brody, Rev Chil Ter Ocup 16 (2) (2016) 55.
[31] Ministerio de Salud de Chile [Internet]. Metas 2011-2020. Elige vivir sano. Available in: http://www.bibliotecaminsal.cl/estrategia-nacional-de-salud-metas-2011-2020..
[32] Ministerio de Salud de Chile [Internet], Formulación Objetivos Sanitarios de la Década 2021-2030 (2022). Available in: https://estrategia.minsal.cl.
[33] R. Hernández-Sampieri, C. Mendoza, Metodología de la investigación. Las rutas cuantitativa, cualitativa y mixta, Ciudad de México, México, Editorial Mc Graw Hill Education, Año de edición, 2018, pp. 714–748.
[34] S. Lloret, A. Ferreres, A. Hernández, I. Tomás, El análisis factorial exploratorio de los ítems: una guía práctica, revisada y actualizada, An. Psicolog. 30 (3) (2014) 1151–1169.
[35] Chión, Charles, Analítica para la Modelación Estructural (1° edición), Perú, Pearson Perú, 2016, pp. 239–322.
[36] L. Vega, Regiones de Chile, Available in: https://regionesdechile.cl/, 2022.
[37] Gartenlaub-González, Andrea G El Maule hoy, Perspectivas y aproximaciones socio-históricas, económicas y medioambientales del Valle Central/Andrea Gartenlaub-González, Felipe Tello-Navarro, editores, RIL editores • Universidad Autónoma de Chile, – Santiago, 2021, p. 408, 21 cm. ISBN: 978-956-01-0886-9, https://ediciones.uautonoma.cl/index.php/UA/catalog/download/118/168/520-1?inline=1.
[38] B. Yáñez, Liliana, Ficha Regional: región del Maule, actualización abril, Biblioteca ODEPA (2023). Available in: https://bibliotecadigital.odepa.gob.cl/handle/20.500.12650/8961.
[39] D.L. Bandalos, S.J. y Finney, Factor analysis: exploratory and confirmatory, in: G.R. Hancock y, R.O. Mueller (Eds.), Reviewer's Guide to Quantitative Methods, Routledge, New York, 2010, 2010.
[40] H.A. Freiberg, J.B. Stover, G. de la Iglesia, L.M. Fernández, Polychoric and tetrachoric correlations in exploratory and confirmatory factorial studies, Prensa Médica Latinoamericana - ISSN 1688-4094 Ciencias Psicológicas VII (2) (2013) 151–164.
[41] E.R. Pérez, L. Medrano, Análisis factorial exploratorio: bases conceptuales y metodológicas, Revista Argentina de Ciencias del Comportamiento 2 (1) (2010) 58–66.
[42] J. Lévy, J. Varela, Modelación con estructuras de Covarianzas en Ciencias Sociales, Netbiblio, Madrid, 2006.
[43] J.E. Collier, Applied Structural Equation Modeling Using AMOS: Basic to Advanced Techniques, Taylor & Francis Group, 2020.
[44] G.W. Cheung, C. Wang, Current approaches for assessing convergent and discriminant validity with SEM: issues and solutions, Acad. Manag. Proc. 2017 (1) (2017) 12706, https://doi.org/10.5465/AMBPP.2017.12706abstract.
[45] H. Wu, S.O. Leung, Can Likert scales be treated as interval scales? A simulation study, J. Soc. Serv. Res. 43 (4) (2017) 527–532, https://doi.org/10.1080/01488376.2017.1329775.
[46] A. Rodríguez, S.P. Reise, M.G. Haviland, Evaluating bifactor models: calculating and interpreting statistical indices, Psychol. Methods 21 (2) (2016) 137–150, https://doi.org/10.1037/met0000045.

[47] Puello-Alcocer, Elsy Cecilia, Ortega-Montes, Jorge Eliecer, Valencia-Jiménez, Nydia Ninna, El significado de felicidad desde la percepción de un grupo de adultos mayores de la ciudad de Montería (Córdoba, Colombia), Index Enferm. 27 (1–2) (2018) 33–37, july 28 2023, http://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S1132-12962018000100007&lng=es&tlng=es.
[48] M.A. Kantún Marín, J. Moral de la Rubia, M.V. Gómez Meza, B.C. Salazar González, Validación del índice de satisfacción con la vida en la tercera edad, Aquichan 13 N° 2 (2013) 148–158.
[49] S. Chen, A. Calderón-Larrañaga, M. Saadeh, I.M. Dohrn, A.K. Welmer, Correlations of subjective and social well-being with sedentary behavior and physical activity in older adults-A population-based study, The journals of gerontology. Series A, Biological sciences and medical sciences 76 (10) (2021) 1789–1795.
[50] E.A. McMahan, D. Estes, Age-related differences in lay conceptions of well-being and experienced well-being, J. Happiness Stud. 13 (2012) 79–101, https://doi.org/10.1007/s10902-011-9251-0.
[51] Bohórquez María del Rocío, Lorenzo Macarena y García Alfonso Javier, Felicidad y actividad física en personas mayores, Escritos de Psicología 6 (nº 2) (2013) 6–12.
[52] D. Godoy-Izquierdo, R. Lara, M.L. Vázquez, F. Araque, J.F. y Godoy, Correlates of happiness among older Spanish institutionalised and non-institutionalised adults, J. Happiness Stud. 13 (2012) 24–52.
[53] A.J. García, M. Marín, M.R. y Bohórquez, Autoestima como variables psicosocial predictora de actividad física en personas mayores, Rev. Psicol. Deporte 21 (2012) 195–200.
[54] M. Roheger, E. Kalbe, A. Corbett, H. Brooker, C. Ballard, Predictors of activities of daily living in heathy older adults: who benefits most from online cognitive training? Brain and behavior 11 (11) (2021) e2388.
[55] Troncoso Pantoja Claudia, Soto-López Nayadeth, Funcionalidad familiar, autovalencia y bienestar psicosocial de adultos mayores, Horizmed v18n1.04 (2018).
[56] K. Álvarez, A. Delgado, J. Naranjo, M. Pérez, A. Valdés, Evaluación funcional del adulto mayor en la comunidad, Rev. Cienc. Med. (Lourenco Marques) 16 (2) (2012) 124–137.
[57] Y. Pinillos, E. Prieto, Y. Herazo, Nivel de participación en actividades sociales y recreativas de personas mayores en Barranquilla, Colombia, Rev salud pública. 15 (6) (2013) 825–833. Available in: http://www.redalyc.org/articulo.oa?id=42231751005.
[58] H. Toyoda, C. Hayashi, T. Okano, Associations between physical function, falls, and the fear of falling among older adults participating in a community-based physical exercise program: a longitudinal multilevel modeling study, Arch. Gerontol. Geriatr. 102 (2022) 104752.
[59] A. Sia, W.W.S. Tam, A. Fogel, E.H. Kua, K. Khoo, R.C.M. Ho, Nature-based activities improve the well-being of older adults, Sci. Rep. 10 (1) (2020) 18178.