Valuing the impact of Self-rated Health and Social Support on life satisfaction among Hong Kong Chinese population

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Abstract

Background: Research has highlighted that satisfaction in health and social support are key areas of life affecting individual's wellbeing. Many social and public health initiatives use these two intervention mechanisms to improve individual's wellbeing. For the purpose of cost-benefit assessment, there has been growing interest in expressing these intervention effects in economic terms. However, only a handful of studies have ever estimated these effects in economic terms, and none of which examined in a Chinese context. The aim of this study is to extend this line of valuation work to estimate the implicit willingness-to-pays on the effects of improving individuals' self-rated health status (SRH) and social support (SS) on their life satisfaction in the Chinese population.

Methods: Using individual's life satisfaction data from a two-wave representative panel survey in Hong Kong (n = 1,109), this study first conducted a cross-lagged analysis with structural equation modelling technique to examine the causal effects of SRH and SS on life satisfaction, while simultaneously adjusting their reverse causal influences. The use of this cross-lagged approach was the effort to minimising the endogeneity problem. Then, substituting the respective estimates to the formulae of compensating surplus, the marginal rate of substitution of SRH and SS with respect to individual's equivalised monthly household were estimated and were then expressed as the willingness-to-pays on the effect of improving individuals' SRH and SS on their life satisfaction.

Results: The cross-lagged analysis ascertained the casual effects of SRH (β = 0.078, 95%CI: 0.020, 0.151) and SS on individuals' satisfaction with life. The sample's marginal rate of substitution of *SRH* and *SS* were found to be 1.28 (95%CI: 0.43, 2.15) and 1.36 (95%CI: 0.23, 2.49) respectively. Translating into the concept of compensating surplus, the implicit monetary values of improving the sample's *SRH* from "poor health" to "excellent health" and their *SS* from "little support" to "a lot of support" are equivalent to an increase in their equivalised monthly household income by HK$56,000 and HK$39,400 respectively.

Conclusions: This study has implications for the cost-benefit assessment in wellbeing initiatives for the Chinese population.

Keywords: Wellbeing valuation, self-rated health, social support, willingness-to-pay, social impact assessment, Chinese

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Background

In recent years the concept of individuals' wellbeing has increasingly taken centre stage in public policy discussion. An increasing number of policy thinkers have emphasised a key objective of health and social policy is to improve individuals' wellbeing and collectively raise population welfare [1-4]. Worldwide, policy initiatives to enhance population wellbeing have been growing, such as enhancing access to health care and building social support and community cohesion. Interest in assessing the effectiveness of the wellbeing policy has been stacking up, and the preference to capture the impact in some form of economic cost-benefit analysis is common [5, 6].

While cost-benefit analysis has been used in a wide array of policy domains, it can be challenging when applied to wellbeing policy, since impacts of many of these initiatives such as improving health status and social support are difficult to measure in economic terms (i.e., non-market goods without direct monetary value). Previous research has developed valuation methods to resolve this challenge, either through the revealed-preference approach or the stated-preference approach [7-10]. However, through decades of research, it is known that multiple factors in the valuation process, such as the cognitive biases caused either by the experimental settings or due to a non-equilibrium market, could affect the valuation decision and hence leads to inadequate estimates [11-15].

Against this backdrop, recent research has developed the use of subjective wellbeing data, such as life satisfaction, as an alternative non-market valuation approach [13, 16, 17]. In this context,

measures of life satisfaction that capture individuals' appraisals of their overall quality of life with regards to past experience, expectations of the future, and comparison to others [18], are considered to be indicators of one's utility [19]. Surveys that explore how exposure to some non-market circumstances could causally affect individuals' life satisfaction are then interpreted as a direct empirical approximation of how the goods of interest alter individual welfare. Then, by weighting against the causal effect of household income on individuals' life satisfaction, they together form the implicit willingness-to-pay (WTP), or the 'shadow price', of the goods of interest (i.e., additional income to pay or accept in order to compensate for the changes in satisfaction with life for the losses or gains in some particular conditions). Scholars have highlighted that this wellbeing valuation approach does not rest upon individuals' decisions in the valuation process, hence avoiding potential cognitive biases that could have been involved in the stated-preference and revealed-preference methods [20, 21].

The use of this wellbeing valuation approach has gained considerable traction in recent years and has started to be applied in estimating the economic term for various health and social conditions. Internationally, a handful of studies have used this wellbeing valuation approach to estimate the effects of improving the self-rated status and social support on life satisfaction [20, 22-26]. However, the estimates derived from these studies varied considerably. For instance, a study in the United Kingdom estimated that the economic value of improving an individual's self-rated health from 'poor health' to 'excellent health' is equivalent to increasing his/her annual household income per capita £303,000 [22], other studies reported a substantially smaller estimate (e.g., US$1,644 - $1,692 from Chandoevwit & Thampanishvong's study [25]; see Additional file 1). Some variation of the estimates may be methodologically related as some of the prior work ignored the endogeneity issue in their estimation [22, 26, 27], which is a methodological concern that could introduce biases and cause an overestimation of the monetary value of the non-market goods [27, 28]. Also, many of these existing valuation work were conducted in the Western setting. To the best of the author's knowledge, only two studies have used this wellbeing valuation approach to estimate the effects of improving health status and social relationship on life satisfaction in an Asian context [25, 26], and none of which examined in a Chinese context. Hence, to fill this research gap, the aim of this study is to extend the literature by using the

wellbeing valuation method to estimate the implicit WTPs of the effects of improving individuals' self-rated health status and social support on their life satisfaction in the Chinese population.

The measure of individuals' satisfaction with life has been conceptualised as one of the major indicators of one's overall wellbeing [29, 30], and a substantial body of research from the domains of life literature has postulated that individuals' wellbeing depends on their appraisals on various aspects of daily life activities [31, 32]. Previous research has highlighted that several areas such as health status and social relationships, and among some others (e.g., material wellbeing, work, community etc.) are the key areas that determine individuals' assessment of life [33, 34]. Self-rated health status, a measure of one's overall physical and mental health condition, has been shown to be related to individuals' satisfaction with life. Impaired health is associated with a decline in positive affect and an increase in negative feelings, such as a depressed mood and anger [35]. In addition, with worsening health, individuals' involvement in social activities is likely to be restricted, and they, therefore, have a limited social connection [36, 37]. Extent research has also demonstrated that individuals having greater social support tended to have a higher level of life satisfaction. Social support, which refers to individuals' actual or perceived available social resources coming from their networks, such as family, friends, co-workers, and from other community ties, can enhance bonding and serve as a buffer for negative stressors. Social support as a protective factor has also been found to alleviate the burden of depressive symptoms, generate happiness, and boost overall life satisfaction [38, 39]. This study focused on self-rated health and social support as they are intervention mechanisms commonly used to enhance individual welfare; deriving the monetary value of these two variables provides wide application in cost-benefit policy analysis.

Methods

Sample

Data used in this study were extracted from the Hong Kong Panel Survey for Poverty Alleviation, which is a two-wave household survey with a representative sample recruited through a stratified random sampling strategy by 412 geographical constituency area. The panel survey involved conducting face-

to-face interviews with the household head to elicit a variety of information; Each interview lasted approximately 60 minutes. Content of the survey and details of the sampling strategy has been reported elsewhere [40]. The first wave of the panel survey was conducted between September 2015 and April 2016, in which 2,002 households were recruited. These households were interviewed again 12 months after the first interview (the second wave), and 1,109 households were retained (retention rate: 50.2%). Given that a notable proportion of the sample recruited in the first wave was lost in the follow-up, the Inverse Mills analysis was conducted to explore the potential sample selection bias, and the result did not indicate a substantial concern (Inverse Mills Ratio: 1.66; $p = 0.678$).

This study retrieved data on the sample's socioeconomic and demographic characteristics (i.e., age, sex, educational attainment, marital status, employment status, housing tenure, household size, and monthly household income), and their status of self-rated health, social support, and satisfaction with life. The sample's self-rated health status was assessed by a single item eliciting their overall health (1 = poor health to 5 = excellent health). Previous studies have shown that this is a valid and reliable measure for one's overall physical and mental health condition [41], reflects participation in health risk behaviours [42], and predicts mortality risk [41]. The sample's level of social support was assessed using three items exploring the levels of perceived available support from their family members and friends (1 = little support to 4 = a lot of support). Three types of social support were elicited, including instrumental support, informational support, and emotional support [43]. For life satisfaction, the five-item Chinese version of the Satisfaction with Life Scale (SWLS) was employed to elicit sample's satisfaction with life. The total scores of the SWLS range from 5 (extremely dissatisfied) to 35 (extremely satisfied). The Chinese version of the SWLS has been validated and was found to have adequate validity and reliability [44].

Statistical analyses

Analysis in wellbeing valuation work can be generally conceptualised as having two-part. The first part involves a regression analysis estimating the effects of some non-market conditions (i.e., self-rated health and social support) on life satisfaction and respectively the effect of an economic indicator (e.g., household income) on life satisfaction. Estimates of these effects would then form the marginal rate of

substitution of the non-market conditions with respect to the economic indicator. As mentioned earlier, one major methodological concern that could introduce biases in this part of estimation is the endogeneity issue [45] and failing to account it can cause an overestimation of the monetary value of the non-market goods [27, 28]. Studies typically used instrumental variables to handle the problem, but the use of the instruments also has its own constraints. Specifically, variables that qualify as an instrument should fulfil the independence assumption, i.e., the instruments should not share causes with the outcome variables (e.g., life satisfaction). Researchers have highlighted that it is very difficult to identify appropriate instruments that meet this assumption [27], as "almost every factor determines life satisfaction" [46].

An alternative way to tackle the endogeneity issue in wellbeing valuation is the use of a cross-lagged analysis [47]. A typical cross-lagged model would examine six effects between two variables. For instance, applying in an examination of the relationships between SRH and life satisfaction (LS), two reflects the temporal autoregressive effects of the variable of SRH and LS (β_a: the causal effects of SRH_1 on SRH_2 and LS_1 on LS_2, respectively) and two cross-sectional correlations between SRH and LS (β_{cor}: the correlations between SRH_1 and LS_1 and SRH_2 and LS_2, respectively). The remaining two effects examine the reciprocal nature between SRH and LS, which is the causal effect of SRH_1 on LS_2 (βc) and the reverse causal effect of LS_1 on SRH_2(βrc).

In the context of this valuation work, the main subject of interest is the βc (e.g., the causal effect of SRH_1 on LS_2), as it will be used for calculating the marginal rate of substitution. Specification of the other five effects are ways to reduce the endogeneity problem in the estimation process. Specifically, given the endogeneity bias typically arises from reverse causality (βrc) and omitted influences on the dependent variable (e.g., temporal autoregressions, β_a,and cross-sectional correlations, β_{cor}) [45], the cross-lagged model explicitly addressing them help to reduce these potential influences in the estimation of the causal effect of *SRH* on *LS*. The cross-lagged model is computed based on a structural equation modelling (SEM) technique, which is a form of simultaneous regression technique often used in the work of subjective wellbeing valuation. Previous studies have used SEM to examine the causal

determinates of life satisfaction [48], and recent valuation studies have used this technique in valuing environmental goods [46].

In this study, a cross-lagged model was specified to examine the relationships among the variables of SRH, SS, HI, and LS. The full model analysed all the effects between the pairs of HI, SRH, SS, and LS within and across the two timepoints. In addition, sample's sociodemographic characteristics were hypothesised as covariates and were regressed on the outcome variables (HI, SRH, SS, and LS). To check the model adequacy, the model's comparative fit, parsimony correction, and absolute fit were assessed using the goodness-of-fit indices commonly used in the SEM technique, including the comparative fit index (CFI) and Tucker-Lewis index (TLI), the root mean square error of approximation (RMSEA), and root mean square residual (MRSR). According to Hu and Bentler's principle [49], the model is considered as having an adequate fit with the data when the CFI and TLI are >.90, the RMSEA <0.06, and SRMR <.08.

For the SEM estimation, data merged across the two waves of the survey was used for model fitting. Sociodemographic characteristics of the sample and their scores of *SRH*, *SS* and *LS* across both waves are reported in Table 1. Samples' equivalised monthly household income was derived from dividing their monthly household income to the square root of the household size. Also, the second wave sample's monthly household income was deflated by the consumer price index for a valid reflection of the real changes of household income. Following convention, standardised coefficients of the cross-lagged model in SEM were reported.

Table 1 Sample's socioeconomic characteristics and descriptive statistics on the main variables of interest (N = 1,109)

Building upon the findings from the cross-lagged analysis, the second stage of valuation procedure was to estimate the WTPs of *SRH* and *SS* on *LS*. Specifically, the estimated causal effects (βc) of SRH_1 and SS_1 on LS_2 as well as HI_1 on LS_2 were used for computing the marginal rate of substitutions of *SRH* and *SS* with respect to *HI,* respectively. Subsequently, it is substituted into the formulae of compensating surplus [21] expressed as,

$$\overline{w} - e^{[ln(\overline{w}) - \frac{\beta_a}{\beta_b}\Delta x]},$$

where $\overline{w}$ is sample's median equivalised monthly household income, β_a/β_b was the marginal rate of substitution, and Δx is the change in the non-market condition (i.e., *SRH* or *SS*). Estimates yield from the formulae reflects the WTP of the condition, which can be interpreted as (hypothetically) the amount of additional equivalised monthly household income required to equate the changes in life satisfaction in relation to the increase or decline either in *SRH* or *SS*.

Results

Cross-lagged analysis of the relationship between SRH, SS, HI, and LS

Using the SEM technique, the hypothesised cross-lagged model denoting the complex relationships among *SRH*, *SS*, *LS*, *HI*, and the socioeconomic variables as covariates were examined. Model diagnostics suggested that there was an adequate fit between the specified model and the empirical data, as all the goodness-of-fit indices met the Hu and Bentler's threshold (CFI = .93, TFI = .92, RMSEA = .05, SRMR = .07).

Figure 1 summarises the major findings of the cross-lagged analysis on the relationships among *SRH*, *SS*, *HI*, and *LS*. There are a number of noteworthy observations. First, the model indicated that there were strong causal associations among the four variables across the timepoints (the curved arrows in Figure 1; e.g., HI_1 □ HI_2: $\beta = 0.458$, 95%CI: 0.296, 0.619). The model also pointed to some significant cross-sectional correlations between the variables of SRH, SS and HI, and LS at each wave (i.e., $SRH_1 \leftrightarrow SS_1$: β = 0.107, 95%CI: 0.037, 0.196; $SRH_2 \leftrightarrow SS_2$: β = 0.122, 95%CI: 0.049, 0.199; $HI_2 \leftrightarrow LS_2$: β = 0.101, 95%CI: 0.042, 0.160, not shown in Figure 1 for the purpose of parsimony). Second, mutual causality was detected among the relationships between *SRH* and *LS* and between *HI* and *LS*. Specifically, the model indicated the casual effects of SRH_1 and HI_1 on LS_2 were significant; one standard deviation increases in *SRH* and *HI* were casually associated with a standard deviation increase in *LS* by the unit of 0.078 (95%CI: 0.020, 0.151) and 0.061 (95%CI: 0.009, 0.112), respectively. At the same time, the reverse causal influences of LS_1 on SRH_2 and HI_2 were also significant. Comparing the

magnitude of the estimates, the reverse causal effects of LS_1 on SRH_2 and HI_2 were even greater than their respective causal effects (the effect of LS_1 on SRH_2, β = 0.086, 95%CI: 0.020, 0.151; the effect of LS_1 on HI_2, β = 0.073, 95%CI: 0.020, 0.151). For the relationship between *SS* on *LS,* while the causal influence of *SS* on *LS* was found to be significant (β = 0.083, 95%CI: 0.014, 0.152), its respective reverse causal effect was however not detected. Overall, R^2 suggested the model accounted for 45%, of the variance of the variables of LS_2.

Fig. 1 The causal and reverse causal effects of household income, self-rated health, and social support on life satisfaction

The implicit WTPs of SRH and SS on LS

Based on the results of the cross-lagged analysis (Figure 1), the marginal rate of substitution of *SRH* and *SS* on *LS* were estimated to be 1.28 (95%CI: 0.43, 2.15) and 1.36 (95%CI: 0.23, 2.49), respectively. This is interpreted as respondents' increase (decrease) in *LS* owing to their improvement (deterioration) in *SRH* and *SS* is equivalent to the effect of increasing (reducing) their *HI* by 1.28 and 1.36 unit of standard deviation respectively. Substituting it into the formulae of compensating surplus, the implicit WTPs of improving the sample's *SRH* from "poor health" to "excellent health" and enhancing their *SS* from "little support" to "a lot of support" are thus equivalent to an additional increase in their equivalised monthly household income by HK$56,000 (95%CI: HK$26,900, HK$68,600) and HK$39,400 (95%CI: HK$10,800, HK$48,300), respectively.[1]

Discussion

Drawing data from a representative panel survey in Hong Kong, this study examined the causal effects of change in self-rated health and social support on individuals' overall satisfaction with life. Adopting the wellbeing valuation method [13, 16, 17], this study expressed these causal effects in an economic

[1] Estimation of the WTPs of SRH and SS were based on the formulae of compensating surplus. In this estimation, $\overline{w}$ is the sample's equivalised monthly *HI*: HK$14.2k.

term (i.e., WTPs). To the best of the author's knowledge, this is the first to derive the shadow price of self-rated health status and social support in a predominantly Chinese society. It extends the wellbeing valuation literature on health and social outcomes as it is one of the few conducted in an Asian context.

This research has implications for the practice of social impact evaluation. Specifically, the derived shadow price of self-rated health and social support provide ways to tie social impact evaluation with some forms of cost-benefit analysis (e.g., social return on investment), which is a tool where policymakers commonly relied on for decision making [5]. Currently, in the absence of culturally-attuned economic proxies, practice among social impact evaluators sometimes apply economic proxies derived from other socio-cultural context (e.g., Western settings) to monetise social non-market outcomes, despite the notable cultural difference on individuals' evaluation on domains of life [50, 51]. This study offers a way to make socio-cultural embedded cost-impact assessment plausible in the Chinese context.

Findings of the cross-lagged analysis illustrated that the relationships among the examined variables are complex. First, the model reflected the existence of significant autoregressive correlations within each main variable of interest (i.e., SRH, SS, HI, and LS). This is fairly intuitive given the timeframe between two data collection timepoints was not long (i.e., approximately twelve months). In addition, cross-sectional correlations among the variables of interest were also detected (e.g., between SRH and SS). The finding is in line with the domains-of-life literature highlighting the intertwining nature among individuals' various aspects of life [31]. Furthermore, the results not only showed the existence of the causal influences of self-rated health, social support, and equivalised monthly household income on samples' satisfaction with life, it also suggested that the reverse causal mechanisms among these variables were significant. Particularly, the sample's baseline life satisfaction was positively and casually associated with their equivalised monthly household income and self-rated health, respectively. Previous research has illustrated that individuals with greater life satisfaction are more productive and are more likely to be promoted and hence may earn a higher income [20, 52, 53]. Positive affect has also been shown to improve the immune system and reduce a person's susceptibility to illness [54, 55]. Taken together, results of this study, on the one hand, add to a large pool of literature illustrating individual's wellbeing as constitutes of multiple areas of life, it nevertheless reflects the

plausibility of the situational mechanism in which one's overall wellbeing affects their different spheres of life [30].

The existence of the reverse causal influences existed in the relationship between sample's HI and LS and between SRH and LS further affirms the need to attend the endogeneity problem in the regression analysis, in order to avoid an overestimation of the implicit monetary value of health and social outcomes [27, 28]. In addition, this study also shows collinearity likely exists between exogenous variables (i.e., social and health conditions), it serves as a reminder for researchers to attend to this problem in future wellbeing valuation studies. The cross-lagged approach simultaneously addresses the cross-sectional associations between the exogenous variables and the reverse-causal influences could be a plausible way to minimise the endogeneity issue in this line of valuation work.

This study is the first to derive the implicit monetary values of self-rated health status and social support on individual's life satisfaction in predominantly Chinese society. Also, unlike some prior work, this study employed statistical procedure in order to minimise potential bias in the estimation process arising from the endogeneity issue. However, it is not without limitations. First, this study was secondary data analysis, and hence the selection of variables for model estimation was restricted by the original survey design. Second, although it is aware that the causal relationship between *SRH*, *SS* and *LS* may vary across age and sex [56], this study, however, did not perform sub-demographic analysis owing to a limited power due to the restricted sample size. While the WTPs estimated in this study may reflect the implicit monetary value of self-rated health and social support among the general population, caution should be exercised when generalising it to particular sub-demographic groups. Further research is warranted to estimate the variation. Third, as in almost all wellbeing valuation analysis, it cannot rule out the possibility that endogeneity still existed in the estimates, as the problem can arise from other sources (e.g., measurement error) that may not be able to be controlled from a statistical standpoint.

Conclusions

This study offers a way to monetise the impact of increasing individuals' self-rated health status and social support on their overall satisfaction with life. It has practical implications for the use of social cost-benefit analysis in assessing wellbeing policy initiatives for the Chinese population.

Supplementary Information

Additional file 1: Implicit WTPs of self-rated health status and social support from wellbeing valuation studies in an Asian context.

Abbreviations

SRH: Self-rated health; SS: Social Support; CI: Confidence Interval; WTP: willingness-to-pay; LS: Life Satisfaction; HI: Household Income; SEM: Structural Equation Modelling; CFI: Comparative Fit Index; TLI: Tucker-Lewis Index; RMSEA: Root Mean Square Error of Approximation; MRSR: Root Mean Square Residual

Declarations

Ethics approval and consent to participate

The ethical considerations were approved by the Human Research Ethics Committee, the University of Hong Kong (HREC Reference Number: EA1506006). The author declares that all methods were performed in accordance with the relevant guidelines and regulations. Informed consent was obtained from all individual participants included in the study.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Competing interests

The author declares that he/she has no competing interests.

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Author's contributions

CHC conceived of the study, designed, executed the statistical analyses, and drafted the manuscript.

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Author's information

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Figures

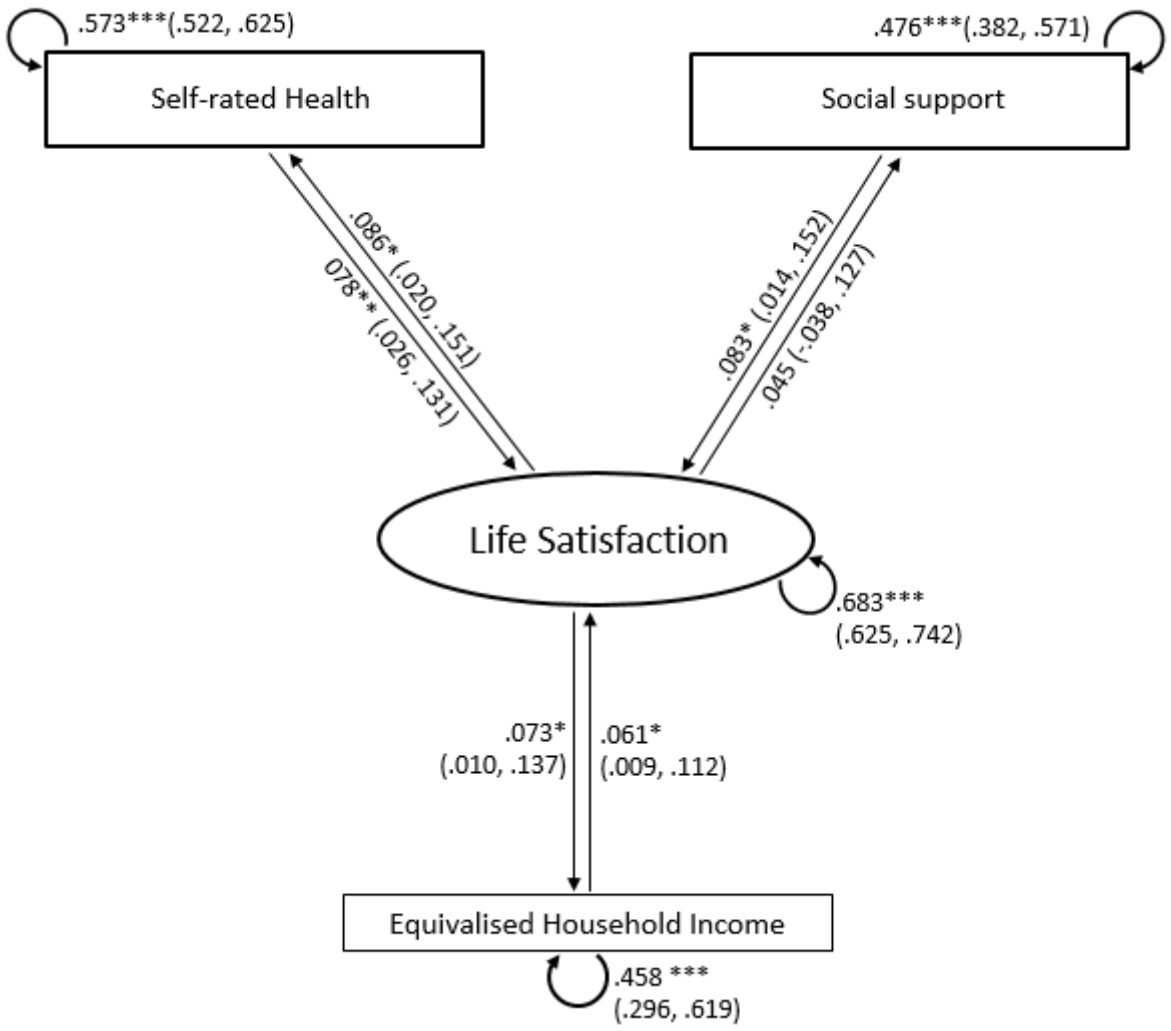

Figure 1

The causal and reverse causal effects of household income, self-rated health, and social support on life satisfaction

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