

Latent Transition Analysis indicates four relatively stable profiles of loneliness in New Zealand

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Loneliness is the social pain or aversive feeling of longing that occurs when people's perceived relationship experiences fall short of their desires for relationships.¹⁻⁴ Specifically, a person's felt loneliness is their subjective perception of lower social belonging, and it is thus distinct from being 'alone'; People can experience loneliness while maintaining close social connections and, equally, experience objective isolation without feeling lonely.^{5,6} People who feel lonely tend to experience poorer physical and psychological wellbeing⁶⁻⁹ and ultimately are at heightened risk of dying.¹⁰⁻¹²

One means of understanding the prevalence, societal patterns and psychological correlates of loneliness is by identifying its typology. Past research using latent profile methods commonly identifies four profiles of loneliness.¹³⁻¹⁵ However, research has been limited to cross-sectional data. There is a pressing need to understand the extent to which loneliness changes over time and identify the people who are relatively more vulnerable to become lonely.¹⁶ In the current pre-registered study, we replicate and extend research on loneliness profiles. First, we tested replication of the four-profile typology of loneliness. Next, we tested the patterns of transition into and from distinct loneliness profiles over a two-year span (from 2014 to 2016). Finally, we examined potential risk factors for loneliness in exploratory analyses testing whether older age and poorer health co-varied with transitioning into higher-loneliness profiles.

Abstract

Objective: We investigated the characteristics of loneliness by identifying distinct 'profiles' of loneliness and investigating transitions between those loneliness profiles over two years.

Method: We conducted Latent Transition Analyses on two years of data from the New Zealand Attitudes and Values Study (N=15,820) and modelled how people's health and age were associated with changes in profile membership.

Results: Four loneliness profiles emerged: 'low-loneliness' (58% of the sample), 'high-loneliness' (5%), 'appreciated outsiders' (28%; perceived acceptance from others but felt like social outsiders), and 'superficially connected' (9%; lacked acceptance from others but felt socially included). Profile membership was relatively stable over time and transitions were most likely from higher to lower loneliness. Younger people and people reporting poorer health were more likely to transition into profiles with greater loneliness indicators.

Conclusions: Findings replicated a four-profile pattern of loneliness, supported the theorised 'trait-like' structure of loneliness and identified the possibility that moderate states of loneliness are transitional states into/from low and high loneliness.

Implications for public health: The stability of loneliness across years reiterates the need for societal interventions, particularly interventions that are adaptive to whether people's loneliness forms as a lack of acceptance/value or a lack of social inclusion.

Key words: belonging, psychological health, statistics, wellbeing, social support

Understanding loneliness via profiles

Different patterns of loneliness emerge in populations. Latent Profile Analysis commonly identifies four distinct profiles of loneliness, including in samples of adolescents in Ireland,¹⁴ in a panel sample of retired adults in the USA¹⁵ and in a sample of adult New Zealanders aged between 18 and 90 years.¹³ All past studies identified a similar four-profile typology despite using different measures of loneliness. Across studies, the largest proportion of people (40-60%) tended to be categorised into a 'low-loneliness' profile, indicating higher levels of felt connectedness and belonging with others.

Two intermediate profiles also commonly emerged as an appreciated outsider profile (i.e. experiencing interpersonal acceptance while still feeling like an 'outsider') and the converse 'superficially connected' profile (i.e. a lack of felt value and acceptance from others but not feeling like an 'outsider').¹³ These intermediate profiles likely index the theorised distinction between social loneliness and emotional loneliness as well as the distinction between high-*quality* and high-*quantity* relationships that are each separate characteristics of measured loneliness.^{3,14,17,18} Finally, the smallest proportion of people are typically classified

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into a 'high-loneliness' profile, representing relative isolation in close relationships and in society.¹³⁻¹⁵

Current theoretical perspectives expect loneliness to be relatively stable across time. People who are disconnected from others typically experience an enduring or severe form of loneliness.⁶ Indeed, meta-analytical findings indicate that chronic and severe patterns of loneliness tend to resemble a personality trait in which people feel disconnected across different contexts,^{19,20} which is consistent with estimated heritability of loneliness at approximately 45%.²¹ For example, people higher in loneliness are less able to capitalise on the benefits of interpersonal interaction because they withdraw from social situations, fail to perceive support that is offered by others and retain relatively higher levels of stress even when being supported, ultimately reinforcing feelings of loneliness.²²⁻²⁴

Although profile-based research on loneliness distinguishes between individuals at high, intermediate and low patterns of loneliness in ways that are consistent with a 'trait-like' structure of loneliness,^{13,14} these studies are typically cross-sectional and thus cannot test the stability of profiles across time. Investigating the likelihood of transitioning into/from distinct profiles of loneliness is necessary for researchers to identify those at the greatest risk of becoming lonely and thus longitudinal analyses are a prerequisite for future interventions. In the current research, we extend profile-based research by testing the transition likelihood of loneliness profiles across time to examine the theorised stability of loneliness.

Investigating the stability of loneliness is the first step to identifying what makes people more vulnerable to becoming lonely. Initial research on an older-aged sample in the US indicates profiles of loneliness are moderately stable – retired people classified in a given profile were likely to be re-classified in that profile four years later.¹⁵ However, people who transitioned into the 'high-loneliness' profile were most likely to be from the 'intermediate' profiles of loneliness of 'appreciated outsiders' or 'superficially connected' (i.e. feeling a lack of acceptance in either community or close relationships).¹⁵ The patterns of transition from intermediate into 'high-loneliness' profiles is consistent with a process in which people's loneliness accompanies behaviors and perceptions that diminish the benefits of receiving social

support.²² In the current research, we also test the likelihood of transitioning into and from loneliness profiles across time to identify the groups at risk of severe loneliness.

Extending prior research on the change in loneliness, we also examine two potential associates of profile change – age and subjective health. Older age groups are expected to be at a relatively higher risk of changes in loneliness due to the relatively lower accessibility of social networks.²⁵⁻²⁷ Similarly, poorer health has bidirectional links with loneliness – poorer subjective health, sleep difficulties and functional health limitations (e.g. difficulty walking upstairs) predicts more subsequent loneliness in the future, and vice versa.^{8,9,28,29} Thus, a final goal of our research was to test whether the likelihood of transitioning into 'intermediate' profiles of loneliness or a 'high-loneliness' profile was magnified for older people or people with poorer health.

Current research

We had three sets of hypotheses [pre-registered predictions and analyses were made in the Open Science Framework; <https://osf.io/2d96x/>]. First, we aimed to replicate four-profile typology of loneliness in two measurement waves (2014 and 2016) of the New Zealand Attitudes and Values Survey (NZAVS). A prior study using the 2013 wave of NZAVS data ($N=18,264$)¹³ and following criteria for identifying the best-fitting model that we replicate and describe in more detail below, identified four profiles of loneliness: *low-loneliness* (57.9% of the population), *appreciated outsiders* (29.1%), *superficially connected* (7.2%), and *high-loneliness* (5.7%). We hypothesised that the same four profiles of loneliness would emerge in the 2014 and 2016 waves (*Hypothesis 1*). Second, we tested patterns of transition into/from loneliness profiles across these two years. We hypothesised that the *low-loneliness* and *high-loneliness* profiles would show relatively high stability (i.e. >70%) over two years, consistent with the trait-like stability of loneliness (*Hypothesis 2*).¹⁹

Finally, we tested potential risk factors for loneliness by predicting profile transitions. Specifically, we modelled the degree to which people's age and wellbeing were associated with the likelihood of transitioning into the intermediate loneliness profiles or a *high-loneliness* profile. We hypothesised that the probability of transitioning into profiles that have higher indicators of loneliness would be

greater for relatively older people (*Hypothesis 3a*) and for people with relatively poorer self-rated health (*Hypothesis 3b*).

Method

Sampling procedure

We drew from Time 6 (2014) and Time 8 (2016) data of the New Zealand Attitudes and Values Survey (NZAVS), a nation-wide longitudinal study of New Zealanders. NZAVS data consist primarily of participants randomly selected from the New Zealand Electoral Roll starting in 2009 and continuing annually. Initial eligible participants were registered voters in New Zealand between 18 and 65 years of age (required age at first measurement was due to longitudinal retention goals). Participants complete questionnaires annually via mailed surveys or an online questionnaire. Retention rate is relatively high (>70%) and supported by booster sampling.³⁰ Sibley reports details on sampling strategy, retention procedures and ethical approval (obtained from The University of Auckland Human Participants Ethics Committee) for each NZAVS wave.³⁰

Participants

Survey responses were 15,820 at Time 6 (2014) and 21,936 at Time 8 (2016). For the current research, analyses on the transition across time included 12,398 participants who were retained in both waves. The mean age at Time 6 was 49.33 years ($SD=14.03$) and Time 8 was 49.62 years ($SD=13.93$). Relative to the census of the New Zealand population, the NZAVS oversampled women (Time 6=63.2% women; Time 8=62.6% women, Census estimate=52.1%) and the majority ethnic group of New Zealand Europeans (Time 6=81.6%, Time 8=82.8%, Census Estimate=75.1%).

Measures

Indicators for Loneliness Profiles. At both timepoints, participants completed three felt belongingness items adapted from Hagerty and Patusky^{31,32}: "I know that people in my life accept and value me", "I feel like an outsider", and "I know that people around me share my attitudes and beliefs" (1=Strongly Disagree to 7=Strongly Agree; $\alpha_{\text{Time 6}}=0.60$; $\alpha_{\text{Time 8}}=0.58$). These items are comparable to other measures of loneliness (see Table S1 in the Supplementary File for more details). Following prior research,¹⁵ items were coded so that higher scores indexed greater

loneliness. Participants who completed (vs. did not complete) the Time 8 wave indicated slightly lower loneliness on two of the three indicators at Time 6 (“accept and value” $\beta = -0.04, p < 0.001$; “outsider” $\beta = -0.01, p = 0.13$; “share my attitudes” $\beta = -0.02, p < 0.001$), although effect sizes were very small.

Covariates. We assessed age (calculated from participants’ reported date-of-birth) and self-reported subjective health at Time 6 as covariates of profile transition. Subjective health was measured with three items from the Short-Form Subjective Health Scale:³² “In general, would you say your health is ...” (1=Poor to 7=Excellent), “I seem to get sick a little easier than other people” and “I expect my health to get worse” (1=Strongly Disagree to 7=Strongly Agree; $\alpha_{\text{Time 6}} = .61$). Participants who completed (vs. did not complete) the Time 8 wave of the NZAVS were relatively older ($\beta = 0.10, p < 0.001$) and relatively higher in self-reported health ($\beta = 0.06, p < 0.001$) at Time 6, although effect sizes were small.

Results

Analyses were conducted using Mplus (version 8.4) using maximum likelihood estimation.³³ The analytic plan was a pre-registered replication and extension (<https://osf.io/2d96x/>) of Hawkins-Elder et al.¹³ First, we conducted Latent Profile Analyses (LPA) to identify the number of profiles that best fit patterns of loneliness, predicting that a four-profile model would display the best fit (Hypothesis 1). In addition, we expected replication of Hawkins-Elder et al. findings for links between loneliness profiles and auxiliary variables (e.g. gender, socioeconomic deprivation, employment status; reported in full in the Supplementary File).¹³ Second, we examined transitions into/from profiles over a two-year period using Latent Transition Analysis (LTA), predicting high stability (>70%) of ‘low-loneliness’ and ‘high-loneliness’ (Hypothesis 2). Finally, we added age and self-rated health as covariates to the LTA, testing whether transition probabilities into the intermediate and ‘high-loneliness’ profiles would be significantly higher for older age (Hypothesis 3a) and lower self-rated health (Hypothesis 3b).

Profiles of loneliness and their characteristics

We first tested Hypothesis 1 by conducting a series of LPA with a range of possible latent profiles (2–7) to identify the best-

fitting model of patterns of loneliness in the population. The sample-size-adjusted Bayesian Information Criterion plateaued at four latent profiles and the four-profile solution had the highest entropy (0.81) of all models after this plateau. Moreover, the Lo-Mendell-Rubin test indicated the four-profile solution fit the data significantly better than the three-profile solution, but no evidence that the five-profile solution was a better fit than the four-profile solution. Results from the bootstrapped likelihood ratio test and Akaike’s Information Criterion favored models with more profiles, likely due to the high sample size.¹³ However, typologies including more than four groups were not practical or interpretable (e.g. the 7-profile solution contained three groups that were each smaller than 3% of the sample). Full results and fit statistics for each model are reported in the Supplementary File (Table S2, Table S3, and Figure S1).

Results supported a four-profile solution (see Figure 1). Most people (58.38%) were classified into the ‘low-loneliness’ profile indexed by low scores on all three loneliness items. By contrast, 5.34% of the population scored high on all three loneliness items and were classified as ‘high-loneliness’. The remaining two profiles formed intermediary loneliness profiles: 28% of the sample were classified as ‘appreciated outsiders’ (i.e. identified as feeling like outsiders but felt

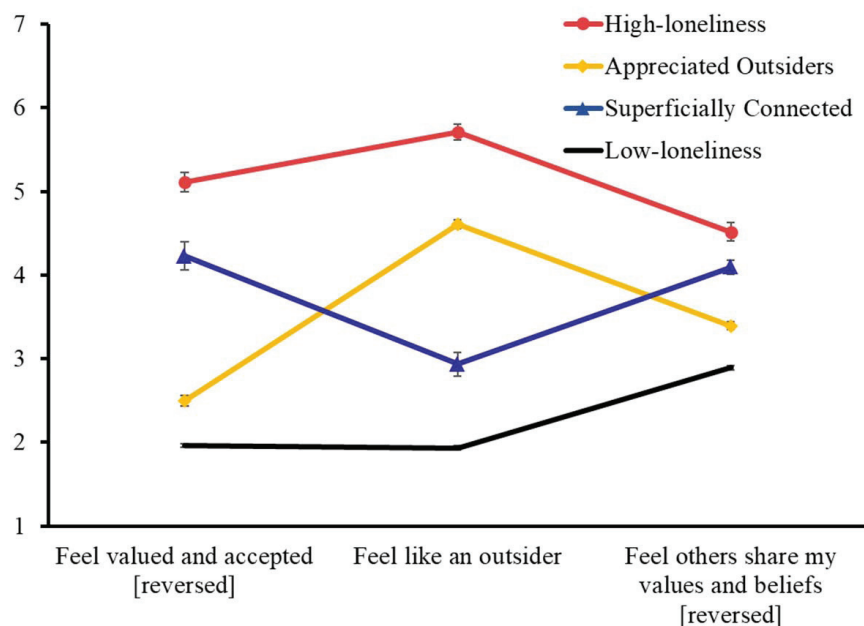
valued and accepted by others), whereas 8.62% were classified as ‘superficially connected’ (i.e. reported low felt value and acceptance from others but did not feel like an outsider).

Moreover, differences between the four loneliness profiles on wellbeing-related auxiliary variables (e.g. self-rated health, self-esteem, psychological distress) consistently indicated that psychological wellbeing indicators were highest for the ‘low-loneliness’ profile and lowest for the ‘high-loneliness’ profile (see Figure S2 and Tables S5 and S6 in the Supplementary File). In sum, results supported Hypothesis 1. The four-profile solution, and the robust pattern of links between higher loneliness and poorer psychological wellbeing, replicated the pattern reported in prior typology research.^{13–15}

Latent Transition Analysis of loneliness profiles

We next tested the stability of the four loneliness profiles across the two years (from 2014 to 2016) by conducting a Latent Transition Analysis (LTA). This model estimated the probability of belonging to each profile at each time point *and* the probability of transitioning from one profile to another across time. In the first stage of analysis we established the fit of the four-profile solution for the transition across time

Figure 1: Latent Profile Analysis in the New Zealand population (N = 15,820) displaying scores on the three indicators of belonging (1 = Strongly Disagree; 7 = Strongly Agree) for the four profiles of loneliness. Error bars indicate 95% confidence interval for estimated means.



at both timepoints, because the best-fitting model at a single time is not necessarily the best-fitting model across all points of measurement.³⁴ The hypothesized four-profile model, constraining parameters to equality at both timepoints, was again a good fit for the data ($entropy=0.832$, $AIC=225,485$, $aBIC=225,624$; $N=12,024$) and replicated profiles of 'low-loneliness', 'appreciated outsiders', 'superficially connected' and 'high-loneliness' (see Supplementary Figure S3).

We next investigated the stability of profile membership, and the likelihood of transitioning into/from each profile over the two-year period. Consistent with Hypothesis 2, profile membership was generally stable across time: Estimates of profile stability (represented by semi-circular arrows in Figure 2) indicated that the majority of people in a given profile were retained in that profile two years later. Stability estimates were highest (87.7%) for the 'low-loneliness' profile and relatively lower, albeit still stable (60.0%), for the 'high-loneliness' profile. Indeed, for people who transitioned into another profile, the most likely transitions were out of the 'high-loneliness' profile to the more intermediate profiles of 'appreciated outsiders' (21.6%) or 'superficially connected' (15.4%; see arrows between profiles in Figure 2). In turn, the most likely transitions from each of these intermediate profiles were to the 'low-loneliness' profile (15.1% and 12.2%,

respectively). Finally, it was extremely rare for transitions to occur from the 'low-loneliness' to the 'high-loneliness' profile (0.4%).

Altogether, the results provide partial support for Hypothesis 2 by showing high stability of the low- and 'high-loneliness' profiles (>60%, and not >70% as predicted). Moreover, the pattern indicated that transitions most commonly occurred from 'high-loneliness' to the intermediate-loneliness profiles, and in turn, from the intermediate-loneliness profiles to the 'low-loneliness' profile. In addition, transitions from the 'low-loneliness' profile were most likely to be toward profiles with moderate indicators of loneliness rather than directly transitioning to the 'high-loneliness' profile.

Covariates of transitions in loneliness profiles

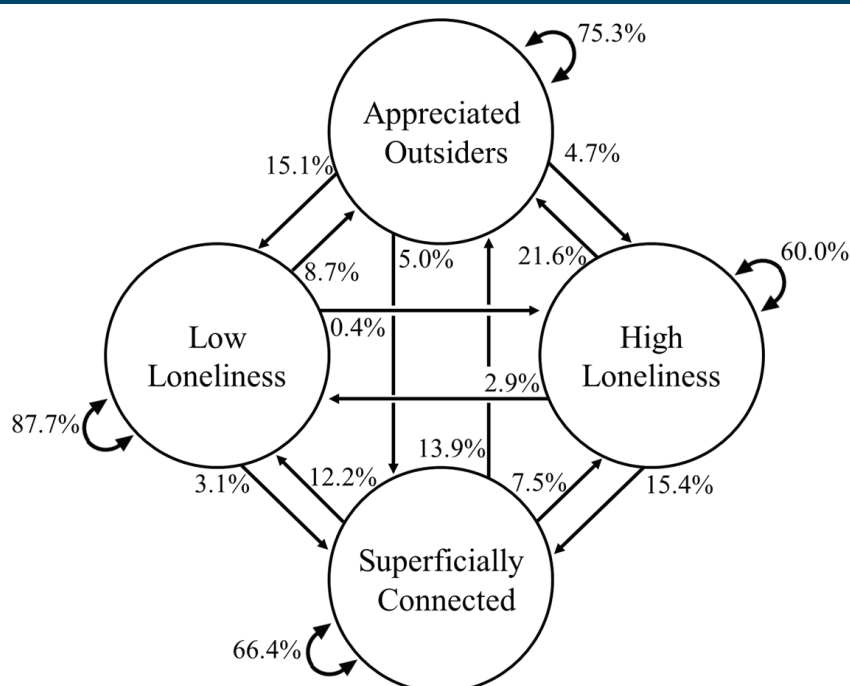
Our final analysis investigated the extent to which age and self-rated health were associated with transitions into/from loneliness profiles following the approach from Nylund et al.³⁵ The model estimates the probability that an individual belongs to the group who changes loneliness profiles (i.e. *movers*) and the probability that an individual belongs to the group who remains in the same profile (i.e. *stayers*), rather than 'post-hoc' identifying individuals who changed profiles in the LTA. When covarying for age

and self-rated health, 53.54% of the sample were classified as movers and 46.46% were classified as stayers (i.e. the model over-classified the number of movers relative to the LTA). The model simultaneously regressed the likelihood of individuals being a *mover* vs. *stayer* on their age and self-rated health. In addition, the model estimated the specific covariance between age and self-rated health with the likelihood of transitioning into the 'appreciated outsiders', 'superficially connected' and 'high-loneliness' profiles, relative to the 'low-loneliness' profile as the reference group.³⁵ In sum, the model conservatively re-estimated transition probabilities while adjusting for people's age and health, and tested Hypotheses 3a and 3b—older individuals and those with poorer health are expected to be more at risk of transitioning into profiles indicative of higher loneliness.

Transition probabilities in the *mover-stayer* model indicated the estimated stability of all profiles of loneliness remained high (>80%), and that profile transitions were most typically from profiles with higher indicators of loneliness toward profiles with lower loneliness indicators. Thus, results indicated the same pattern reported above even when statistically adjusting for age and self-rated health. In general, older age was associated with a greater likelihood of classification as a *stayer* ($B=0.006$, $SE=0.002$, $t=2.69$, $p=0.007$, odds ratio=1.006) and greater self-rated health was associated with a lower likelihood of classification as a *stayer* ($B=-0.094$, $SE=0.026$, $t=-3.67$, $p<0.001$, odds ratio=0.91), compared to classification as a *mover*. Thus, the average trends were for younger people and people in poorer health to be more likely to transition into/from profiles of loneliness.

Finally, we examined the extent to which participants' age and self-rated health were linked with the probability of transitioning into any of the three profiles indicative of higher loneliness, relative to the 'low-loneliness' profile used as the reference group. Results are displayed in Table 1. First, older people were less likely to transition into both the 'appreciated outsider' profile and 'high-loneliness' profiles than younger people. There was no evidence that age was significantly associated with transitioning into the 'superficially connected' profile two years later. Thus, contrary to Hypothesis 3a, evidence indicated that the stability of profile membership was overall greater for older

Figure 2: Markov chain model displaying the class stabilities and transition probabilities for the longitudinal four-profile model of loneliness between Time 6 (2014) and Time 8 (2016) of the New Zealand Attitudes and Values Study.



people than younger people.

People with higher self-rated health were less likely to transition into the 'appreciated outsider' profile, the 'superficially connected' profile, and the 'high-loneliness' profile (Table 1). The odds ratios indicated that likelihood of transition linked with health was relatively more pronounced for the profiles that encompassed a lack of feeling valued and accepted – a one unit increase in health was linked with approximately a halved likelihood of transitioning into the 'superficially connected' and 'high-loneliness' profiles. Thus, supporting Hypothesis 3b, poorer self-rated health was linked with a heightened probability of transitioning into profiles indicative of higher loneliness.

Discussion

The goals of this study were to confirm latent profiles of loneliness in the New Zealand population and to examine transitions into and from those loneliness profiles over a two-year period (from 2014 to 2016). The four-profile solution of 'low-loneliness', 'superficially connected', 'appreciated outsiders' and 'high-loneliness' profiles was the best fit at each measurement wave and the longitudinal change across waves, supporting Hypothesis 1 and consistent with the number and interpretation of loneliness profiles in prior research.^{13–15} We also hypothesised stability across time (>70%) for the low- and 'high-loneliness' profiles (Hypothesis 2) and found supporting evidence for the 'low-loneliness' profile (87.7%) but not the 'high-loneliness' profile (60%). Nonetheless, the membership probabilities for all four profiles were relatively stable across two years ($\geq 60\%$), consistent with the theorised trait-like structure of loneliness.^{19,21} We add to evidence that the prevalence of loneliness is troublingly high but stable—loneliness has not markedly increased (or decreased) over time.^{19,21} Indeed, supporting the impetus to address loneliness, we replicated links between loneliness profile membership and auxiliary variables (see Section 2.2 of the Supplementary Material), such that the 'high-loneliness' profile was associated with poor self-rated health, low self-esteem, psychological distress, lower life satisfaction and perceived support. Thus, our results join the robust literature that labels loneliness as a serious indicator of poor health and mortality risk.^{2,6,11}

We extended profile-based research on

Table 1: Tests of the degree to which participants' age and self-rated health covaried with the likelihood of transitioning to three loneliness profiles (Appreciated Outsider; Superficially Connected; High Loneliness) relative to the 'Low Loneliness' profile.

Profile Transition	Estimate	S.E.	t	Odds Ratio
Appreciated Outsider				
Age	−0.031	0.002	−12.96*	0.97
Health	−0.352	0.029	−11.98*	0.70
Superficially Connected				
Age	−0.000	0.003	−0.11	1.00
Health	−0.662	0.031	−21.43*	0.52
High Loneliness				
Age	−0.039	0.003	−11.67*	0.96
Health	−0.868	0.036	−25.19*	0.42

Note:

Health was measured on a 7-point scale (Poor to Excellent).

* $p < 0.001$.

loneliness by testing theory that age and self-rated health are risk factors for transitioning into lonelier profiles. Including age and self-rated health in the model increased estimates of profile stability, suggesting that differences in age and self-rated health accounted for change in loneliness profiles. Intriguingly, and against Hypothesis 3a, younger individuals were significantly more likely to change profiles than older individuals. This unexpected finding is nonetheless consistent with young adults being at a greater risk for loneliness because their perceived relationship experiences are relatively more dependent on the consistency of finances and connection with friendship groups.^{7,36} Conversely, loneliness in older people may present as more stable and thus be resistant to intervention.²⁶ In particular, younger (vs. older) people were more likely to transition into the 'appreciated outsider' and 'high-loneliness' profiles, indicating the unique importance of broader social connection to loneliness transition in younger ages. Due to model constraints, we were unable to test more complex relationships with age. For example, we could not test potential curvilinear effects such as whether the youngest and oldest adults have a heightened likelihood of profile change relative to middle-aged adults.

People in poorer health were more at risk of loneliness, consistent with Hypothesis 3b. Specifically, people who reported poorer subjective health were at greater risk of transitioning into profiles with higher levels of loneliness, particularly into the 'superficially connected' and 'high loneliness' profiles. In sum, results were consistent with theory that the link between loneliness and poorer physical health is bidirectional.^{8,9,28,29}

Furthermore, profile transitions followed the theorised process in which the loneliness–health link is partly due to people's withdrawal from close others as a form of self-protection.¹⁷ That is, people in poorer health may be motivated to prevent harming the relationships that are most important to maintain and thus they avoid their closest connections at the risk of their own wellbeing. A 'withdrawal as self-protection' process is consistent with the finding that the majority of profile transitions occurred into/from the 'superficially connected' and 'high loneliness' profiles (i.e. the two profiles that were low on the 'value and acceptance' indicator). Indeed, also replicating prior research,¹⁵ transitions directly from the 'low-loneliness' to the 'high-loneliness' profile were rare. Altogether, the structures and predictors of the 'superficially connected' and 'appreciated outsiders' profiles suggested the existence of intermediary profiles that are two distinct transitional states that bridge the extremes of low and high loneliness.

Implications for public health

The quality and quantity of relationships are two different sources of social need fulfilment.^{14,15,17,18} Those with limited but higher quality relationships, the 'appreciated outsiders' may feel a perceived absence of broader societal belongingness that can be buffered by close connections. By contrast, those with a higher quantity of distant relationships, which may map the profile of 'superficially connected', may be able to access social belonging but nonetheless lack closeness and intimacy. Each of these types of loneliness possibly represents a distinct pathway toward high loneliness, consistent

with several theoretical perspectives.^{3,17,18} Indeed, the transition probabilities in the current research converged with those of Wu et al. by indicating that the 'superficially connected' (emotional loneliness) profile had poorer wellbeing (see Section 2.2 of the Supplementary Material) and a greater rate of transition to 'high-loneliness' than the 'appreciated outsiders' (social loneliness) profile.¹⁵ Hence, results affirmed the message of *quality over quantity* when considering the characteristics of relationships that foster wellbeing,^{10,11,14} but also strengthened the theoretical perspective that lacking *either* facet of social connection represents a distinct course toward high loneliness and thus each needs particular consideration when assessing psychological wellbeing in the public.

The findings also reiterate the need for public health interventions for those in the 'high-loneliness' profile, who reported the lowest psychological wellbeing, as well as the two profiles indicating moderate levels of loneliness. This was particularly the case for individuals in the 'appreciated outsiders' profile who reported high probability of remaining within the profile (75.3%) over two years, compounded by the highest transition probability into this profile from the 'high-loneliness' profile (21.6%). Younger-aged people in the 'low-loneliness' profile were also relatively more likely to transition into the 'appreciated outsiders' profile than older-aged people. Thus, distinguishing between forms of loneliness – such as distinguishing low-quality vs. low-quantity connections – may require considering relatively stable traits. For example, interventions for loneliness in younger ages should consider how emotional stability/neuroticism interact with typical developmental stressors in early adulthood, such as the need to balance career- and family-related demands.³⁷⁻³⁹ By contrast, poorer health (but not age) predicted a greater likelihood of transitioning into the 'superficially connected' profile. Thus, for people in poorer health, there is a specific need to understand the contextual factors that limit their ability to access broader social belonging. Thus, we reiterate calls from researchers for health interventions to mitigate the simultaneous risks of poor health for people's loneliness by finding ways to boost people's social inclusion.^{1,10,16}

Future research directions and limitations

Future research should seek to generalise our findings in new sociocultural contexts. The four-profile model of loneliness, made up of profiles that are generally stable across time, has been replicated across different Western samples using distinct loneliness measures.¹³⁻¹⁵ However, the antecedents of loneliness differ cross-culturally. To illustrate, the loneliness of people in individualistic European societies is best predicted by lacking interactions with friends or personal confidants, whereas loneliness in collectivist societies is best predicted by lacking interactions with family.⁴⁰ Moreover, Canadian (individualist) youth attributed their loneliness relatively more to personal and developmental deficits than did Portuguese (collectivist) youth,⁴¹ indicating that cultural differences modulate people's attributions for their loneliness. In sum, trajectories of people's loneliness (and associated covariates) are likely to differ in more collectivist cultures. Future cross-cultural latent transition analyses could test cross-cultural variance in the structure of, and transitions in, loneliness profiles, and thus the extent to which cultural interdependence alters the form and development of loneliness.

Our study also had methodological strengths and limitations relative to past research identifying forms of loneliness. Examining the transitions in profiles across time and covariates of those changes extends all prior research on loneliness profiles, including evidence for the relative trait-like stability of loneliness over time and critically novel information on transitions across loneliness profiles. However, our findings were limited to a two-year interval as a (pre-registered) timespan for change, and the findings cannot be generalised to longer timeframes. Moreover, our findings do not afford causal inferences and we cannot ascertain directionality in the associations involving the auxiliary variables or the covariates of change across time. Given that loneliness and poorer health are theorized to be bidirectionally connected,^{9,28} the relationships we examined are likely to be reciprocal across time. Finally, the pre-registration and data collection were conducted prior to the COVID-19 pandemic, which has since impacted people's wellbeing and access to social relationships.⁴² Future research should test transitions in loneliness profiles across timespans including pre- and

post-pandemic data to examine the personal and societal impacts of the pandemic on loneliness.¹⁶

Conclusion

Loneliness is detrimental for psychological and physical wellbeing and thus researchers need to investigate its prevalence and stability. Our research contributes to understanding loneliness by investigating how people transition into and from different forms of loneliness over time. We replicated a four-profile typology of loneliness in New Zealand and that members of the loneliest profile had relatively poorer wellbeing, are more introverted and more emotionally unstable. The loneliness profiles were relatively stable over time, and in particular, individuals rarely transitioned between the extreme types of loneliness over the two-year span. The distinct intermediary profiles of loneliness – 'superficially connected' and 'appreciated outsiders' – may function as transitional states into and from the lower and higher loneliness profiles that could be targeted in future public health interventions.

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Supporting Information

Additional supporting information may be found in the online version of this article:

Supplementary File: Online supplementary material.