Does Medical Risk Perception and Risk Taking Change With Age?

ABSTRACT

Across adulthood, people face increasingly more risky medical problems and decisions. However, little is known about changes in medical risk taking across adulthood. Therefore, the current cross-sectional study investigated age-related differences in medical risk taking with N = 317 adults aged 20–77 years using newly developed scenarios to assess medical risk taking, and additional measures designed to evaluate risk-taking behavior in the medical domain. Greater expected benefits on the Domain-Specific Risk-Taking Scale—Medical (DOSPERT-M) predicted more active risk taking, whereas higher perceived risk predicted less active risk taking. Next, we examined differences in active and passive risk taking, where passive risk taking refers to risk taking that is associated with inaction. Age was associated with less passive risk taking, but not with active risk taking, risk perception, or expected benefits on the DOSPERT-M. Participants were overall more likely to opt for taking medical action than not, even more so for a scenario about a vaccine for a deadly flu than for a scenario about a chemotherapy treatment for cancer. Overall, participants were more likely to accept medication (vaccine or chemotherapy) for their child than for themselves. Increasing age was associated with a lower likelihood of accepting the treatment or vaccine for oneself. Taken together, our study provides important insights about changes in medical risk taking across adulthood when people face an increasing number of complex and risky medical decisions.

Keywords: DOSPERT-M; Medical; Adulthood and Aging; Omission; Risk taking.

1 Introduction

Nearly half of lifetime health-related expenditure is incurred in old age: The average 85-year-old in the United States spends about $17,000 per year on his or her health, while those in their 20s spend less than one tenth of that sum ($1,448)[1]. One of the reasons for the sharp increase is the rise of multimorbidity (i.e., multiple chronic conditions) with age. Compared to younger adults, older adults are far more likely to have multiple chronic diseases, such as hypertension, heart disease, and diabetes[2], requiring more complex and risky decisions regarding treatments and medication than single, more short-term diseases. Thus, older adults tend to face more costly and risky medical decisions.

1.2 Age, Risk taking and risk perception

There is surprisingly little data on how age affects risk attitudes and perceptions in the medical domain. In contrast, there is a large corpus of evidence on the relation of age and financial risk taking. The bulk of our knowledge on age-related changes in decision making, as Mata and colleagues[3] demonstrated, has emerged from behavioral studies using financial tasks (e.g., hypothetical or actual gambles for money). Based on analysis of 29 previous behavioral studies, Mata et al.[3] found that age-related differences depend on the nature of the risk task, in particular, 16) whether the decision is based on experience or description. In tasks that involve decisions from experience, older adults seem to be more risk seeking than younger adults. In contrast, in risk tasks that are based on description, older adults seem to be risk averse. A large cross cultural study[4], which focused on people’s attitude towards risk, revealed that increase in age was associated with decline in risk taking propensity. Longitudinal data from the German Socio-Economic Panel Study (SOEP)[5] on both attitudes (self-report measures) and behavioral (gambles) risk taking propensities across the lifespan showed that risk taking tends to diminish with age. The authors also found positive correlations between gambling and self-reported general risk attitude. Overall, the above studies suggest that risk taking behavior depends, at least partially, on the nature of the risk measure used. While there is a clear need to distinguish between self-report and behavioral measures of risk taking, some evidence[6-8] indicates that behavioral tasks are related to self-report measures, and self-report measures are correlated with real life risk taking such as gambling and smoking.

One area that has not received sufficient attention in the field of aging and decision making is the medical domain. Understanding medical risk taking is of key importance for a number of reasons. Health expenditure represents one of the largest percentages out of the Gross Domestic Product (GDP), with the U.S. spending over 17% of its GDP on health. Adults 65 years and over far outspend their younger counterparts,[9] and they are significantly more likely to suffer serious illness such as cancer. Indeed, adults 65 years and over are 3 times more likely to die from cancer (18.4 vs. 6.4 per 100,000) compared to those under 65.[9] Reducing cancer rates, thus, can not only reduce mortality and morbidity but also reduce expenditure. A large corpus of data has shown that risk perception is related to a range of medical related behaviors such as cancer screening and adherence to medication. A study[10] of over 1000 older adults (ages 65-89 years) has shown that risk perception is related to colorectal cancer screening. A meta-analytic review[11] reported that one of the key predictors of breast cancer screening was women’s risk perception, and that perceived risk was (weakly) related to age. Others[12] have found that risk perception is associated with male’s likelihood of undergoing genetic screening for prostate cancer. While increasing cancer screening is crucial, somewhat similar concerns can be found with other medial issues. Previous research has demonstrated that risk perception plays an important role in patients’ perception of disease severity. A comprehensive review[13] has found similar trends with regard to adherence to medication, such that higher risk perception was associated with greater adherence. Furthermore, the review pointed out the need to better understand how patients' balance risks and benefits of medication. Taken together understanding how age affects risk attitudes and risk perception in the medical domain has important financial and health implications.

1.3 Risk taking: A question of domain.

Dating back to the early 1960s, Slovic[(14)] questioned the idea that studying a person's financial risk taking was sufficient to predict his or her risk taking in other domains. Other researchers[(15)] have provided empirical evidence to further substantiate the idea that we need to examine more than one risk domain, while others[(16)] have argued that while domain specific framework is useful there is still a scope for a general risk taking disposition. One study[(17)] found that gender differences are not consisted across risk domains. They also reported that gender differences in some domains result from gender differences in risk perception (either likelihood or severity), not risk attitude. Other work[(18)] examined adult age-related differences across five different risk-taking domains, using the Domain-Specific Risk-Taking Scale (DOSPERT)[(19).] Although risk taking in the different domains was correlated, it followed a different age trajectory across the domains.[(18)] While this study did not examine medical risk taking, the results suggest that there was a linear decline in risk taking (e.g., smoking, and drug use) in the health domain across adulthood.

While this earlier study[(18)] provides important data, it focused only on participants' willingness to engage in risky activities and did not examine their perceived risks and expected benefits. These two distinct constructs —perceived risks and expected benefits—are captured by the DOSPERT, which was developed based on the idea that risk-taking behavior is best understood by perceptions of the risks and benefits associated with the risky activity[(19)].[1] Others[(20)] have argued that any discussion about risk taking must incorporate the trade-off between the expected (or perceived) benefits and the expected (or perceived) risks of an activity. Following this line of reasoning, a number of studies[(21-22)] have found a strong relation between perceived benefits and the likelihood of engaging in risky activities. Whether the perceived benefit plays a similar role among older adults' risk-taking tendencies within the medical domain is an open question.

1.4 Omission and commission bias

Survey tools have been useful in gauging people's risk-taking attitudes, especially in trying to capture risk taking across domains. However, as age differences in risky behavior may also depend on the measures used to evaluate risk taking[(23)], there is a need to employ a wide spectrum of instruments to evaluate risk taking tendencies. One line of research[(24)] that could further elucidate age-related difference in risk taking attitude is work on omission/commission bias.[2] The omission/commission bias refers to people's willingness to accept a higher level of risk in order to avoid being the responsible agent for an action that could lead to harm. While the omission/communion bias can be applied to many risk domains, it has been especially useful in the medical/health domains in shedding light on people's decision to accept (or reject) preventative treatments such as vaccination. A common finding is that people avoid immunizing themselves or their children because "they would feel more responsible for the death caused by the decision to vaccinate than for the death caused by the decision to withhold vaccination" (p.

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[1] Interestingly, the DOSPERT risk-return framework is partially grounded on financial risk taking. Unlike the more objective expected value that is used in the financial domain, risk-return framework is seen as a subjective construct (and hence it is termed risk attitude) which is designed to capture individuals' *perceptions* of the risk and benefits associated with a given activity.

[2] The omission/commission bias literature, however, has little to say about possible domain differences in decisions. Nonetheless, employing different tools to examine risk taking can provide a more holistic picture about the relationship between age and risk attitude.

118)[25]. However, not doing everything in one's power to save the life of a person for whom one has assumed responsibility (e.g., one's child) might be perceived as failing in the role of a caretaker. Given the increase in generativity across adulthood,[26] one might expect older adults to show a stronger reversed omission bias than younger adults when the decision concerns their child rather than themselves.

In one illustrative study, researchers[27] asked participants to imagine that they were either a patient, a physician treating a single patient, a medical director creating treatment guidelines, or a parent deciding for a child. Participants were asked to make treatment decisions about a vaccination against a deadly flu and about a slow-growing cancer. Overall, participants were more likely to administer the vaccine and to choose a chemotherapy treatment when deciding for their child than when deciding for themselves. More importantly, those aged 65 years and older were less likely to accept the chemotherapy treatment for themselves but more likely to accept the flu vaccine. The researcher's[28] choice of flu vaccination and cancer treatment could potentially correspond to others'[3] argument that older adults sometimes have difficulties learning from feedback about their risk taking and, therefore, show different decision patterns than younger adults when the decisions are based on newly learned associations. Applied to flu vaccinations and cancer treatments, this would lead to different expectations regarding age-related differences in risky decisions: Given the flu's yearly occurrence, one would expect older adults to have greater experience with flu vaccination than younger adults because they have experienced a greater number of flu seasons. In contrast, given the rarity and the heterogeneity of different kinds of cancer, young and even older adults are more likely to have had limited (to no) experience with cancer treatments.

The omission bias has also been linked to the status-quo bias[29]—a tendency to do nothing or maintain one's current state of affairs. Inspired by these findings, researchers[30] developed a passive risk-taking scale to capture people's inaction or failure to take action in a number of risky domains. That is, unlike other instruments, which measure a person's tendency to engage in risky actions, the passive risk-taking scale evaluates the decision not to take action, such as not attending a medical screening. As age is typically associated with increased attendance at annual medical health checks[31], one might expect older adults to exhibit reduced passive risk taking.

1.5 Numeracy

One factor that has gained prominent attention in the risk-taking literature is numeracy. Referring to people's ability to process and understand numerical information[32], numeracy skills also include the capacity to evaluate risk magnitude, compare risks, and assess risk–benefit trade-offs[33, 34]. Low numeracy is associated with difficulties interpreting risk information.[35] There is also growing evidence that numerical ability declines with age[18] , leading, among other things, to poorer decision making. For example, investigators[36] reported that older adults fared worse both on numeracy tasks and in interpreting medical risk and insurance information. In a review of the numeracy literature, researchers[37] have argued that "low numeracy distorts perceptions of the risks and benefits of screening, reduces medical compliance, impedes access to treatments, impairs risk communication (limiting prevention efforts among the most vulnerable), and …appears to adversely affect medical outcomes" (p. 943). Building on this research, we examined the link between age, numeracy, and medical risk taking.

1.6 The present study

In the present study, our goals were (i) to examine age-related differences in medical risk taking across adulthood; (ii) to evaluate the degree to which medical risk-taking behavior is driven by expected benefits and perceived risks; (iii) to study differences in the omission/commission bias among adults of different ages; (iv) to investigate age-related differences in passive risk-taking tendencies; (v) to explore how the age of the target of the decision (own age vs. child's) affects medical risk-taking decisions; and to (vi) examine the link between numeracy and risk taking propensity. Specifically, we predicted that age is associated with reduced risk taking in the medical domain. We also assumed that for all age groups, perceived benefit plays a more important role in the self-reported willingness to engage in medical risk taking than perceived risk. We hypothesized that older adults are more willing than younger adults to vaccinate but not to undergo chemotherapy for cancer treatment. We also predicted that older adults are more likely to accept the flu vaccine and chemotherapy for their child compared to younger adults, as a form of reversed omission bias. We did not hold a priori hypotheses regarding potential age-related differences in passive risk taking. We also predicted that high numeracy is associated with reduced risk taking tendencies. Finally, as earlier work has shown women take fewer risks,[18,39] we also assumed that women show lower risk taking tendencies.

2 Method

2. 1 Participants

The research protocol was in accordance with the ethics committee at the University of Zurich. A total of 355individuals took part in the study. However, several participants did not complete the survey, or completed it more than once. After removing them from the analysis, a sample of N = 309 adults aged 20 to 77 years (M = 48.90 years, SD =16.48; 63% female) participated in the study. We recruited only MTurk participants with a HIT (human intelligence task) approval rate equal or greater than 95%, and being located in the United States. On average, participants took 11.5 minutes to complete the study. Concerning education, two participants had not completed secondary education, 31% had obtained a college or bachelor's degree, and 16% had obtained a master's or doctorate degree. Participants were recruited from Amazon's Mechanical Turk (Mturk) and received a token payment of U.S. $0.75[39-40].

2.2 Materials

2.2.1 Decision scenarios. The decision scenarios were based on those developed by Zikmund-Fisher et al[27]. Participants read four different scenarios in which they were told that either they or their child was in danger of a deadly flu or had been diagnosed with a deadly, slow-growing cancer. In the first two scenarios, participants were asked to imagine that their local area had been sealed off due to a highly contagious and deadly flu. They were then told that either they (Scenario 1) or their child (Scenario 2) had a 10% chance (10 of 100 people) of dying from the flu. Next, they were informed that a vaccine had been developed and tested that would prevent them (Scenario 1) or their child (Scenario 2) from contracting the flu with absolute certainty. However, there was a 5% (5 of 100 people/children) risk of dying from the vaccine. After reading the scenarios, participants indicated whether they would accept the vaccine for themselves (Scenario 1) or have the vaccine administered to their child (Scenario 2).

Scenarios 3 and 4 followed a similar design, with the exception that participants were asked to imagine that either they (Scenario 3) or their child (Scenario 4) had been diagnosed with a deadly, slow-growing cancer. They were told that if untreated, there was a 15% (15 of 100 people/children) risk of dying from the cancer within 5 years. They were then informed that they (or their child) had two options: Option 1 was to wait and see what will happen with the knowledge that there will be nothing they can do to prevent death if the cancer spreads. The alternative was to accept chemotherapy that would cure them or their child with certainty, but which had a 10% (10 of 100 people/children) risk of causing myelodysplastic syndrome, a fictitious bone marrow cancer that would lead to certain death within 5 years. Participants indicated whether they would accept chemotherapy for themselves (Scenario 3) or their child (Scenario 4). The order of presentation was counterbalanced for the flu and cancer scenarios, and for the options relating to themselves and to their child.

2.2.2 DOSPERT-Medical. The DOSPERT-M[(41-42)] was designed to augment the original DOSPERT[19] by including six items that focus on medical procedures (e.g., donating a kidney). For each item on the DOSPERT-M, participants indicated (1) their likelihood of engaging in the activity (risk taking), (2) how risky they perceived the activity to be (risk perception), and (3) how much benefit they would expect to gain from participating in the activity (risk benefit). All responses were made on a 7-point scale ranging from 1 (*extremely unlikely*) to 7 (*extremely likely*) for the likelihood ratings, 1 (*not at all risky*) to 7 (*extremely risky*) for the risk perception ratings, and 1 (*not beneficial at all*) to 7 (*extremely beneficial*) for the expected benefit ratings. The scale items indicated acceptable reliability (Cronbach's α: active risk taking = .61, risk perception = .65; expected benefits = .64).

2.2.3 Passive Risk Taking Scale. Developed by Keinan and Bereby-Meyer[(29)], the questionnaire measures the tendency for passive risk taking in three domains (resources, medical, and ethical). We used only the seven-item medical domain component of the scale for the present purposes (e.g., "Immediately go to the doctor's when something in my body is aching or bothering me"). Responses were made on a 7-point scale ranging from 1 (*very unlikely*) to 7 (*very likely*) and were reverse scored for the analysis. The scale items were reasonably reliable (Cronbach's α = .65).

2.2.4 Numeracy. Participants completed the four-item objective numeracy scale[(43)], which examines individuals' capacity to answer basic questions of probability (Question 1: "Imagine that we role a fair, six-sided die 1,000 times. Out of 1,000 roles, how many times do you think the die would come up even (2, 4, or 6)?"; Question 2: "Imagine that we are throwing a five-sided die 50 times. On average, out of these 50 throws how many times would this five-sided die show an odd number (1, 3, or 5)?") and percentages (Question 3: In the BIG BUCKS LOTTERY, the chances of winning a $10 prize are 1%. What is your best guess about how many people would win a $10 prize if 1,000 people each buy a single ticket from BIG BUCKS?"; Question 4: "In the ACME PUBLISHING SWEEPSTAKES, the chances of winning a car are 1 in 1,000. What percentage of tickets of the ACME PUBLISHING SWEEPSTAKES win a car?"). Questions were scored as correct (coded "1") or incorrect (coded "0"). Total numeracy scores were calculated by summing correct responses across the four items (ranging from 0 to 4). On average, participants correctly answered 1.89 (*SD* = 1.08; range = 0-4) of the four numeracy items. The majority provided correct responses to Question 1 (70%) and Question 3 (69%), whereas few responded correctly to Question 2 (19%) and Question 4 (32%).

2.3 Procedure

Participants completed the study online. After providing informed consent, they completed the four medical scenarios that were presented either in the sequence of the two vaccination scenarios (self, child) following the two cancer scenarios (self, child) or the other way around. The decision scenarios were followed by the DOSPERT-M, the Passive Risk

Taking Scale, and the numeracy scale. At the end of the survey, participants provided demographic information.

2.4 Analytical Approach

Age-related differences in active and passive risk taking, risk perception, and expected benefits were tested in separate regression analyses that included age as a continuous predictor in a first block and, to explore nonlinear effects, a quadratic term for age in a second block. Multiple regression analyses were conducted on active risk taking on the DOSPERT-M to test for effects of risk perceptions and expected benefits. For this analysis, age, gender, risk perceptions, and expected benefits were included as predictors in a first block. Two-way interaction terms between each of the predictors were included in a second block to test for moderating effects of age and gender.

We probed fine-grained aspects of age trends in active and passive risk taking, risk perception, and expected benefits by calculating mean ratings for a moving 10-year period across the entire age range. The first period in our analysis produced the mean scores for individuals in the 20–29 year age range. The second period shifted by 1-year to include individuals in the 21–30 year age range. Each consecutive period shifted by 1-year intervals (i.e., 22–31, 23–32, and so on) until age 68–77 years. This approach has been used to capture subtle trends in data that can be missed by a single regression model[(44)]. The smaller the period (e.g., 20–29 vs. 20–49) the smaller the overlap across consecutive periods and so the greater the detection of subtle age trends. We struck a balance between the size of the period and its sample size, ensuring that the smallest sample contained no fewer than 34 participants (min = 34, max = 95, *M* = 54.63; *SD* = 17.20).

We used a rolling regression model to probe fine-grained aspects in the effects of risk perceptions and expected benefits on risk taking. We employed the same age periods used to probe age differences in mean scores. The first regression model on risk taking, which included risk perceptions and expected benefits as predictors, was computed for the 20–29 year age range. The second regression model was conducted on the 21–30 year age range, the third model on the 22 – 31 year age range, the fourth on the 23-32 year age range, the fifth on the 24-33 year age range, and so on. Hence, the regression model 'rolled' across the age periods from youngest to oldest, allowing us to investigate changes in the regression coefficients across the entire age range under study. Although adjacent age ranges in the rolling regression overlapped considerably, the full sequence of regressions from the youngest to oldest age ranges can reveal subtle fluctuations in behavior across adulthood that might be missed by a single regression model.

A random effects logit model was conducted to assess participants' decisions to accept the flu vaccine and chemotherapy treatment in the medical scenarios. The random effects approach enabled us to account for the clustering within our data, as all participants responded to all types of scenarios and questions. Scenario (chemotherapy vs. flu), question type (child vs. self), and individual differences in age and gender were included in a first block. In a second block, two-way interaction terms were included involving age and gender.

3 Results

3.1 DOSPERT-M and Passive Risk Taking Scale

Table 1 provides the intercorrelations between the variables. Numeracy correlated negatively with risk perception and positively with passive risk taking. Higher perceived risk correlated with lower expected benefits and active risk taking and higher expected benefits correlated with higher active risk taking and lower passive risk taking. Finally, higher active risk taking was associated with lower passive risk taking.

Our regression analysis revealed that age was associated with less passive risk taking (linear, $\beta = -.12$, $p = .04$; quadratic, $\beta = -.13$, $p = .746$) but not active risk taking (linear, $\beta = -.04$, $p = .50$; quadratic, $\beta = .18$, $p = .65$), risk perception (linear, $\beta = -.05$, $p = .37$; quadratic, $\beta = .29$, $p = .48$), or expected benefits (linear, $\beta = -.09$, $p = .13$; quadratic, $\beta = -.44$, $p = .28$) on the DOSPERT-M. Risk perceptions were negatively associated with expected benefits, indicating that activities perceived as risky were expected to yield fewer benefits. The regression analysis revealed a moderating effect of age on this association ($\beta = -.79$, $p < .01$). As age increased, the negative association between risk perception and expected benefits also increased.

Figure 1B shows the mean group ratings for a moving 10-year period and confirms that passive risk taking generally decreased from 20–29 years ($M = 4.09$) to young middle adulthood (33–42 years: $M = 3.63$) through to 68–77 years ($M = 3.58$), with a jump in late middle adulthood (45–54 years: $M = 4.28$) that, however, was not reflected in a quadratic effect.

As hypothesized, greater expected benefits on the DOSPERT-M predicted greater active risk taking ($\beta = .53$, $p < .001$), whereas higher perceived risk predicted less active risk taking ($\beta = -.30$, $p < .001$). Age ($\beta = -.01$, $p = .91$) and gender ($\beta = .04$, $p = .39$) were unrelated to active risk taking ($\beta = -.01$, $p = .91$). The second block in the regression analysis revealed that age moderated the effects of risk perceptions ($\beta = .55$, $p = .03$) but not expected benefits ($\beta = .18$, $p = .44$). Inspection of the rolling regression analysis for a moving 10-year period (Figure 1A) confirms that risk perceptions influenced risk taking to a lesser degree with increasing age ($\beta_{20–29} = -.43$; $\beta_{68–77} = -.23$).

3.2 Decision Scenarios

Participants were more likely to opt for taking medical action (vaccine, cancer treatment) than for inaction, even more so in the flu vaccine conditions (themselves = 73%; child = 82%) than in the chemotherapy treatment conditions (themselves = 65%; child = 76%; Table 2: Model 1). Overall, participants were more likely to accept the treatment or vaccine for their child than for themselves (Table 2: Model 1). Increasing age (Table 2: Model 1; estimated slope: 20 years = 85%; 77 years = 63%) and being female (Table 2: Model 1; men = 86%; women = 61%) were associated with a lower likelihood of accepting the treatment or vaccine. However, the effect of gender did not reach significance. Figure 2 provides the estimated effects of age and gender on acceptance across the chemotherapy and flu scenarios. Gender interacted with scenario (Table 2: Model 2), such that gender differences were larger for the flu scenario (male = 92%; female = 62%) than the chemotherapy scenario (male = 81%; female = 60%; Figure 2).

4 Discussion

Given the high financial and personal costs associated with medical-related risk behavior, gaining better insights into adult lifespan changes in medical risk-taking tendencies and perceptions is paramount. Using the DOSPERT-M allowed us to examine risk-taking tendencies and perception differences in the medical domain. Our data revealed no age-related differences in medical risk-taking tendencies. This result stands in contrast to the prevailing notion that older adults are more risk averse than younger ones[45]. Given that most empirical studies have used financial scenarios or gambling tasks to investigate age differences in risk taking [3], they might have provided a limited picture with regard to other domains such as the medical risk taking. In line with our findings, there exists evidence [18] that risk taking across adulthood does not take a uniform shape but varies according to domain. Our data, thus, not only highlight the importance of focusing on a specific risk domain[15] but also question the exclusive reliance on financial risk taking in predicting older adults' risk taking in other domains.

That being said, earlier studies using the DOSPERT-M have reported mixed results. While one study[48] found few age-related difference, others[49] reported heightened risk taking among older adults. It is possible that the specific content of the health-related questions in the DOSPERT-M account for these differences. For example, older adults might exhibit more altruistic tendencies, and hence be more likely to donate blood. Indeed, in a series of studies, researchers[50] reported that older adults not only view contributing to the greater good more favorably, but are more likely to act in this manner. Furthermore, some of the questions of the DOSPERT-M might be age specific, such as requiring a knee replacement surgery.

In line with earlier work [19-20], our data indicate that risk-taking behavior can be captured by participants' risk and benefit perception of the given activity. Indeed, in line with our hypothesis, greater expected benefit was associated with greater likelihood of engaging in medical risk taking, and higher rating of risk perception was associated with reduced likelihood of engaging in medical risk taking. Interestingly, with increased age, risk perception played a lesser role and perceived benefit assumed a more prominent one. Note, however, that age was associated with a reduced focus on risk perception and not with overvaluing the benefits.

Earlier work[30] has shown that adults over 50 years attend regular health checks and seek health-related advice more often than their younger counterparts. Our data provide novel support for this pattern, indicating that older adults report reduced passive risk-taking behavior. There are a number of possible explanations for our findings. First, as older adults tend to experience more comorbidity, and they might be more likely to seek out their physicians when feeling unwell. In addition, many health campaigns specifically target older individuals [47], which could help explain greater tendencies to attend screening procedures.

Ritov and Baron's[24] work on the omission and commission bias largely focused on young adults; to our knowledge, few studies have examined age-related changes in this bias. Our results reveal that age was associated with a lower likelihood of accepting both the flu vaccine and chemotherapy treatment for oneself. Furthermore, all age groups were less likely to accept the chemotherapy compared to the flu vaccine. Zikmund-Fisher et al.'s[27] findings were similar: Older adults were less likely to accept chemotherapy than younger age groups. However, their pattern of results differs from ours, as older adults in their study had higher rates of flu vaccine acceptance. We believe that differences in experimental design—Zikmund-Fisher et al.[27] used a between-subjects design whereas ours was a within-subjects design—contributed to differences in the results. Another difference is that we changed the scenario in a way that described a complete lock-down of the flu-infected area to eliminate the possibility that participants would think that, in addition to not doing anything or accepting the vaccine, they had the third option of leaving the area and thereby avoiding infection (for themselves or their child).

Older adults' acceptance rate of the flu vaccine in our study closely matches real-world data, whereas our younger sample's acceptance of the flu vaccine was much higher than real-world data. According to the CDC[47] about 67% of adults aged 65 years and over are vaccinated. In contrast, the high rate of younger adults who accepted the flu vaccine in our study is much higher than reported by the CDC, standing at about 43% for individuals aged 50–64 years and 25% for individuals aged 18–49 years. It is possible that older adults' greater familiarity and experience with the flu vaccine and cancer treatments can account for our results. In other words, older adults' decisions on our task might have been swayed by their personal experience, whereas the younger participants' decisions might have largely stemmed from the information provided in the scenario.

With regard to gender, a systematic review[51] reported that females are less likely to be vaccinated compared to males. Our data reveal similar patterns, such that females were significantly less likely to accept either the flu vaccine or the cancer treatment. Earlier studies[18] have reported that females are more risk averse, corresponding to our results.

When examining the relationship between age and willingness to treat one's child, we found, as expected, that the likelihood of accepting a treatment or vaccine was higher for all age groups for their (hypothetical) child compared to themselves. Indeed, our results follow earlier work[25] that also reported higher willingness to take action when the agent was a child rather than the participants themselves. Furthermore, a study[52] has shown that people are more likely to accept medical treatment for significant others than for themselves. Other finding[53] suggests that decisions made by surrogates are often biased toward the side of accepting. This bias might be even more pronounced when the decision involves children. Furthermore, participants' decisions might have been motivated by anticipated regret, as earlier studies[54] reported that anticipated regret was the most important predictor in decisions to vaccinate.

Counter to our expectations, numeracy levels were unrelated to decisions about whether to accept the flu vaccine and cancer treatment. Earlier work has shown that more numerate individuals have more accurate risk perceptions [37,55], and that accurate risk perception is related to greater uptake of flu vaccine as well as mammography screening.[56] Earlier work [32,57], in addition, has reported a decline in numeracy levels with age. Our data did not reveal similar trends; in our study, age was not associated with reduced numeracy ability. It is possible that older participants on Mturk are more numerate than those in the general population. Also, we used only 4 questions, rather than 11 in the full numeracy scale. Using the extended numeracy scale that contains 11 questions might have produced different results.

The current study has several limitations worth discussing. First, the study is cross-sectional, so that the results might reflect cohort differences rather than developmental changes. Cohort-sequential data examining life-span changes in medical risk taking will provide better insights into how age relates to changes in medical risk taking. Furthermore, all measures used in this study are based on self-reports. Including behavioral measures of actual medical risk taking (e.g., vaccinations) would help to further enhance our understanding about the association of age and medical risk taking. Moreover, we used an MTurk-sample which, although these samples are typically not more selected than other convenience samples,[58] other samples (and measures) should be used to replicate the findings and test for their robustness.

Finally, there are a number of concerns regarding the DOSPERT-M. First, previous studies did find correlations between the DOSPERT-M and some of the other subscales of the DOSPERT. As indicated in the introduction, however, there is enough evidence to question whether knowing a person’s financial risk attitude is sufficient to predict their medical risk attitude. More importantly, there are some concerns about the content validity of the DOSPERT-M, especially as it is applied to an aging population whose medical or health needs might be changing. Indeed, the majority of the questions in the DOSPERT-M refer to not very risky medical procedures (giving blood), and ones that are elective (donating a kidney). None of the questions, for example, capture the types of risky decisions that many cancer patients face. While we acknowledge the possible limitations of the DOSPERT-M, it is, at least at present, the only available instrument to measure medical risk attitude. Indeed, we believe there is an urgent need to develop more comprehensive and possible disease specific risk taking instruments. The lack of widely available instruments served as a partial rational for our inclusion of the omission/commission bias. Given the important and difficult decisions that millions of patients face, coupled with our aging society, there is a clear need to develop more instruments that will allow us to better capture patients' attitude towards medical risky option—in a similar way that financial institutions often gauge their clients' risk profile when making recommendations.

As the proportion of older adults increases in the general population and people live longer than ever before, complex and risky medical procedures and treatments will become more ubiquitous. A better understanding of how age relates to willingness to engage in medical risk taking has clear conceptual and applied ramifications. It is becoming evident that to investigate a complex phenomenon such as medical risk taking, there is a need to employ a variety of tools and measures, especially ones that focus on the medical domain and veer away from financial risk. Indeed, while financial advisers suggest that older adults should stay away from risky financial options, it is not clear whether a similar rationale could be applied in the medical domain and it is even less clear whether older adults would follow such advice.

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Table 1
Pearson Correlations

Measure	Age	Numeracy	Risk perception	Expected benefits	Active risk taking
Age	–				
Numeracy	-.04	–			
Risk perception	-.05	-.15*	–		
Expected benefits	-.09	-.06	-.26**	–	
Active risk taking	-.04	-.06	-.38**	.57**	–
Passive risk taking	-.12*	.15*	-.02	-.23**	-.26**

*$p \leq .05$. **$p \leq .001$.

Table 2
Logistic regression model used to predict likelihood of accepting the treatment or vaccine

Included	*b (β)*	Odds Ratio	95% CI for Odds Ratio	
			Lower	Upper
Model 1				
Intercept	2.348 (1.229)			
Scenario				
chemotherapy vs. flu	-0.447 (-0.224)*	0.640	0.470	0.870
Question type				
Child vs. self	0.615 (0.308)**	1.849	1.356	2.522
Age	-0.024 (-0.387)*	0.977	0.960	0.994
Female gender	-0.580 (-0.280)	0.560	0.309	1.016
Numeracy	0.075 (0.081)	1.078	0.828	1.403
Model 2				
Intercept	4.728 (-0.989)			
Scenario				
chemotherapy vs. flu	-1.435 (-0.718)*	0.238	0.077	0.741
Question type				
Child vs. self	0.061 (0.030)	1.063	0.348	3.245
Age	-0.051 (-0.840)*	0.950	0.909	0.993
Female gender	-2.079 (-1.006)*	0.125	0.027	0.575
Numeracy	0.077 (0.083)	1.080	0.826	1.413
Age X Scenario	0.006 (0.006)	1.006	0.987	1.025
Age X Question type	0.012 (0.012)	1.012	0.993	1.032
Gender X Scenario	1.022 (1.022)*	2.779	1.425	5.419
Gender X Question type	-0.059 (-0.059)	0.943	0.489	1.818

*$p \leq .05$. **$p \leq .001$. The standardized coefficients (*β*) were calculated by standardizing the predictors such that they had a mean of 0 and a standard deviation of 1.

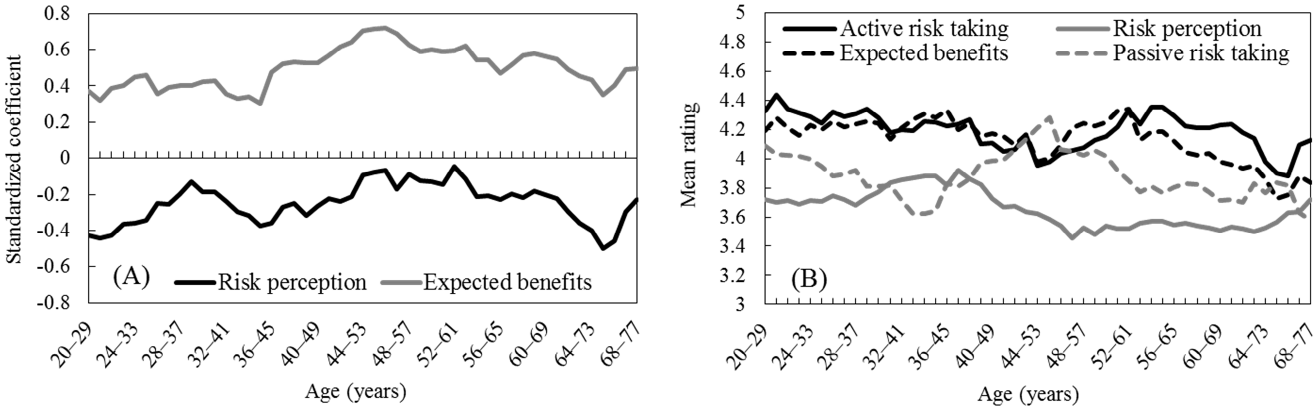

Figure 1. (A) Effects of risk perception and expected benefits ratings on DOSPERT-M active risk-taking ratings based on a rolling regression with a 10-year period from age 20 to 77 years. (B) Mean group scores on the medical subscale of the Domain-Specific Risk-Taking Scale (DOPSERT-M; active risk taking, risk perception, expected benefits) and passive risk-taking ratings for a moving average of a 10-year period from age 20 to 77 years.

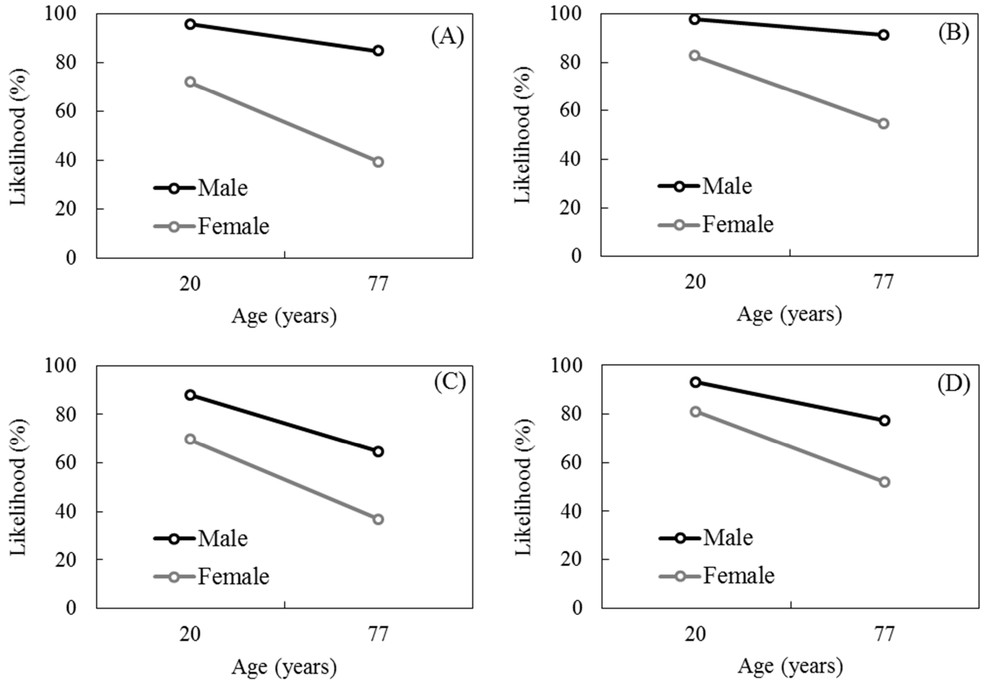

Figure 2. Estimated effects of age and gender on likelihood of participants accepting the flu vaccine for (A) themselves and (B) their child and the chemotherapy treatment for (C) themselves and (D) their child.