Elderly patients’ experiences using adaptive conjoint analysis software as a decision aid for osteoarthritis of the knee

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Abstract

Background Decision making in knee osteoarthritis, with many treatment options, challenges patients and physicians alike. Unfortunately, physicians cannot describe in detail each treatment’s benefits and risks. One promising adjunct to decision making in osteoarthritis is adaptive conjoint analysis (ACA).

Objective To obtain insight into the experiences of elderly patients who use adaptive conjoint analysis to explore treatment options for their osteoarthritis.

Design Participants, all 65 and older, completed an ACA decision aid exploring their preferences with regard to the underlying attributes of osteoarthritis interventions. We used focus groups to obtain insight into their experiences using this software.

Results Content analysis distributed our participants’ concerns into five areas. The predicted preferred treatment usually agreed with the individual’s preference, but our participants experienced difficulty in four other domains: the choices presented by the software were sometimes confusing, the treatments presented were not the treatments of most interest, the researchers’ claims about treatment characteristics were unpersuasive and cumulative overload sometimes developed.

Conclusion Adaptive conjoint analysis presented special challenges to our elderly participants; we believe that their relatively low level of computer comfort was a significant contributor to these problems. We suggest that other researchers choose the software’s treatments and present the treatment attributes with care. The next and equally vital step is to educate participants about what to expect, including the limitations in choice and apparent arbitrariness of the trade-offs presented by the software. Providing participants with a sample ACA task before undertaking the
Introduction

Osteoarthritis of the knee is a common problem in older adults, but identifying the ideal treatment for any individual patient is not guaranteed in any given clinical encounter. Because osteoarthritis is common, effective treatment can produce important societal benefits. By the same token, treatments that cause harm can result in significant morbidity and mortality.

There are many treatments for osteoarthritis, including exercise, non-steroidal anti-inflammatory drugs (NSAIDs), acetaminophen, injections, surgery, creams, opioids and acupuncture. Physicians cannot, and do not, review with patients all the risks and benefits of every intervention. Yet patients are information-avid, often wishing to learn more about the treatments they choose and about treatments they rejected or that were not even mentioned.

Many patients with osteoarthritis, before seeking medical advice, self-treat with over-the-counter medications, particularly NSAIDs. Physicians, in turn, commonly suggest over-the-counter or prescription NSAIDs. While NSAIDs can be helpful in osteoarthritis, their toxicity, and particularly the risk of acute gastrointestinal haemorrhage, is significant. Seven of every 1000 patients with osteoarthritis who take NSAIDs for 1 year have a serious gastrointestinal complication;¹ about 16 500 patients with osteoarthritis and rheumatoid arthritis die as a result of NSAID complications every year in the United States.²

The choice of treatments for osteoarthritis thus presents a double challenge: first, to provide patients with information to make better-informed choices and second, to discourage the unreflective use of NSAIDs, thereby reducing NSAID-related morbidity and mortality. This double challenge, as yet unmet, is a promising opportunity for decision aids.

Decision aids and adaptive conjoint analysis

Decision aids are intended to provide patients with information and guidance to help them make ‘specific and deliberative choices’ that reflect their individual values and preferences.³ Decision aids have been created in many forms, including paper-and-pencil, DVD, audio booklets,⁴ video booklets⁵ and educational soap operas,⁶ and they can enhance patient-physician communication and improve values-based choices.⁷

One approach to clarifying patients’ preferences for complex decisions like the treatment of osteoarthritis is adaptive conjoint analysis (ACA). ACA is a statistical technique used in business since the 1970s to study how buyers value the attributes – or characteristics – of commercial products and services. The idea behind conjoint measurement is that ‘people make decisions about the overall value of a product based on the value of its multiple, combined (conjoint) features… Because not all features are equally desirable, consumers must make difficult trade-offs when making their purchase decisions’.⁸ In ACA, a computer-generated model asks consumer participants to compare realistic product profiles, which allows the software to determine how respondents value the underlying product attributes. Marketing researchers thus use ACA as a tool to probe the preferences behind consumers’ eventual summative choices. For a consumer considering the purchase of a computer, for example, these preferences include features like the size of the screen, capacity of the battery and amount of memory. ACA determines what combination of a limited number of attributes most influences respondent decision making. Conjoint analysis has been applied to topics as diverse as the preferences of Spanish consumers for organic as opposed to conventional eggs⁹ and the purchase intent of Japanese housewives for traditional fermented soy product (natto,
including characteristics such as attached seasonings, cost and country of origin). In a study that bridged the worlds of business and medicine, Waltzman used ACA to evaluate what patients look for in choosing a plastic surgeon so that the surgeons can ‘determine optimal marketing strategies’.

In the medical context, when patients choose between two treatments, they implicitly choose between the attributes of those treatments. Instead of asking patients which treatment they prefer, ACA elicits patient preferences for the characteristics of treatments they favour. So, for instance, two patients might each choose to treat their knee osteoarthritis with an injection, but one might base that decision on the injection’s low risk of side-effects, while another might be hoping for permanent benefit, an unlikely outcome. These favoured (and disfavoured) characteristics can be used in decision support programmes to select treatments tailored to individual patient preferences.

Adaptive conjoint analysis thus offers the opportunity, at least in theory, of looking at the trade-offs that underlie patient choices. By sharing these trade-offs in a transparent manner with patients, ACA can also serve as an educational tool. For instance, a patient might believe his most preferred treatment is an NSAID, but an ACA-guided examination of his preferences might reveal NSAID treatment to be discordant with his preference to avoid significant side-effects.

Adaptive conjoint analysis is now being tested to elicit patient preferences for a variety of conditions. For example, Dwight-Johnson evaluated patient preference for individual vs. group treatment plus medication for the treatment of depression, Bederman identified clinical factors influencing patient and physician preferences for lumbar spinal surgery, and Fraenkel looked at rheumatoid arthritis treatment preferences for drugs with varying risk profiles. Fraenkel has also conducted numerous conjoint analysis studies on osteoarthritis treatment to investigate lack of awareness of drug toxicity or adverse events of NSAIDs, patient preferences for exercise vs. other treatment options and treatment preferences of patients vs. physicians.

**Special populations and ACA**

Adaptive conjoint analysis has been used successfully in a variety of medical decision-making settings, including some that involved participants, who might be expected to have difficulty with a complex computer-based decision aid, such as older participants. Low-income Latino patients with depression have successfully used conjoint analysis, and Bridges found that schizophrenic patients were able to successfully complete conjoint analysis tasks when presented, ‘with little explanation’, by a psychologist.

Despite the theoretical appeal of conjoint analysis, some researchers have encountered difficulty bringing it to bear in a clinical context. Ryan and Markham have shown that excluding characteristics that are important to participants (e.g. allergies or access to treatment) can lead to erroneous results. Others have found that ACA’s complexity can lead to non-response, apparent preference inconsistencies, frustration and difficulty understanding some questions and scenarios. Participants who become overwhelmed are prone to focus on key characteristics (e.g. the most preferred or most disliked) and use simplifying techniques to make choices.

Because others have found challenges in the implementation of ACA in clinical decision making, our study of ACA in older patients with knee pain, following the suggestion of Maddala, included both quantitative and qualitative components. We present here our qualitative findings.

**Methods**

We used ACA software to probe the preferences of 58 elderly participants (46 women and 12 men) towards different knee pain options. Of these participants, 85% were white, 9% were Hispanic and 7% were African American. We recruited participants through newspaper...
advertising and signs placed in local primary care clinics. Eligible participants were aged 65 and older, suffered knee pain over the past month on most days, were able to travel to our office, could read and understand English and were able to answer questions on a computer screen. Their familiarity with computers was assessed at the time of recruitment by simply asking if they were comfortable using a computer. We excluded potential participants who had probable causes for their knee pain other than osteoarthritis or who had contraindications to taking an NSAID. This project was approved by the Baylor College of Medicine Institutional Review Board.

To familiarize our participants with a simple example, the sessions began with a demonstration of how conjoint analysis could be used by a shopper to compare shoes, using shoe comfort, cost and colour as decision attributes. Our participants then undertook the study ACA task. The software began by asking our participants to rank how desirable cream/pills, injections and exercise are as treatment options (Fig. 1) and then to rank the importance of each attribute related to dealing with their knee pain (Figs 2 and 3). Based on these weighted responses, the program presented each participant with 18 paired comparisons of treatments and knee pain outcomes (Figs 4 and 5). It ended with a bar graph indicating the importance of each attribute and a ruler with the postulated best treatment choice for the individual (Figs 6 and 7). We conducted focus groups immediately after our participants completed their ACA task. We here present the results of these focus groups; the results of our quantitative study will be presented elsewhere.

The focus groups were conducted by one of the investigators or a master’s level staff member; the sessions were audio-recorded and transcribed. The focus group discussion guide was drafted, pretested and modified in response to the pretesting. It began with a grand tour question: ‘What was the computer program like for you?’ Additional prompts asked about participants’ understanding and comfort level with the program. Follow-up questions asked whether the program helped patients decide what was important in making a treatment decision with prompts about whether the program reflected their preferences, what they learned from the program and what made it difficult to choose between scenarios. In addition, participants were asked to discuss whether they agreed or disagreed with the preferred treatment predicted by the software. We conducted focus groups until we reached saturation (the point at which responses are being repeated and no new themes are emerging). This required five focus groups with a total of 29 participants.

Analysis

A content analysis was performed on the transcripts from the focus groups. Content analysis is generally used to describe a phenomenon, in this case participants’ experiences and perceptions about the ACA program. Researchers avoid using predefined codes to elicit recurrent concepts, instead allowing these concepts to flow from the data. The concepts are then combined into a smaller number of constructs. As a way of examining the data from different perspectives, the results of the coding process were triangulated between three study investigators.

Results

Content analysis showed that our participants’ concerns naturally grouped into five categories: the predicted preferred treatment, the software, the choice of treatments, the treatment attributes (risks and benefits) and cumulative overload.

The predicted preferred treatment

At the conclusion of the ACA, the software predicted the preferred treatment for each participant. In the focus groups, we asked if they agreed or disagreed with the software’s prediction of their preferred treatment; 66% agreed, 16% disagreed and 19% were unsure.
Figure 1 Screen shot of patient treatment preferences.

Figure 2 Screen shot of most important treatment attribute.

Figure 3 Screen shot of ranked importance of other treatment attributes.
Figure 4 Screen shot of paired comparisons of pain outcomes and treatment options.

Figure 5 Screen shot of paired comparisons of pain outcomes and symptoms.

Figure 6 Screen shot of ranked importance of each attribute.
Software

Our participants all claimed to be comfortable using a computer and were quick to say that the software program was ‘fine’. But their comments about their experience with the software and their difficulty with specific aspects of the program, as outlined below, belie their attempt to appear at ease. Our demonstration of ACA software, applied to the familiar task of comparing the qualities of shoes, helped, but not enough for all of our participants, and some said they were confused by the series of paired comparisons included in the ACA (Figs 4 and 5). As one woman said, ‘I didn’t realize until further over in the program what I was answering questions about and I kind of got mixed up’. Additionally, many participants were troubled that the software, even though its title included the word ‘adaptive’, did not adapt to the preferences they expressed during the program. As one participant said, ‘I don’t want injections at all. They are painful. Why does the program keep asking me if I want them?’

Choice of treatments

The software that we used required us to identify, in advance, the treatments to be considered (we chose seven) and the attributes of each treatment. Other treatments could not be added, and no treatment that was included could be omitted for any particular participant.

This limitation proved difficult for our participants to understand. Some participants were troubled that the ACA program omitted treatments that they considered important, such as surgery or complementary and alternative therapies (e.g. acupuncture, herbal treatments and chiropractic treatment). One person stated, ‘You gave us certain parameters and you had to fill in whatever your feelings were about them without having other options that there obviously are… like acupuncture’. Our participants also indicated that they would have liked to be able to exclude certain treatments categorically, like ‘no injection’ if they were uninterested in receiving this treatment. As one woman said, ‘I felt like there should have been a way to indicate ‘not available’ or something like that. It [injections] never entered into my consideration’.

Treatment attributes – risks and benefits

We provided our participants with a description of each treatment’s benefits and risks (Appendix 1). Much of this information was new to them, however, and sometimes they simply did not believe it. Exercise, which is a safe and effective treatment for osteoarthritis of the knee, was a particular problem. Some participants believed that only vigorous exercise could be helpful; others denied that exercise could be of any benefit at all. One woman commented, ‘I can’t exercise with this. It hurts me a lot to walk’. Echoing this, one of the men stated, ‘I would not likely exercise with this because I don’t do anything that’s strenuous’.

Some treatment attributes were accepted by the participants as accurate but nonetheless discounted. People over 65 qualify for Medicare, and cost was of little concern to many of our participants. Several commented that cost should have been omitted as a treatment attribute. One man observed, ‘The program asks, “Would you take this treatment for $25 and you’re going to...”'
have a bleeding ulcer”? Well no, the money doesn’t even come into consideration’.

Cumulative overload

Many of our participants felt overwhelmed by the number of choices they were given. For some, the multiplicity of treatment possibilities made keeping track of their options difficult. One person stated simply, ‘It was hard to make a decision’. Some participants felt that the paired comparisons were difficult to understand, illustrated by this comment: ‘I kind of got confused after which ones make your stomach bleed and which ones give you stomach upset’. When the software seemed to be asking the same question more than once, some participants felt they were being manipulated. One woman declared, ‘It’s almost like we think you’re trying to trick us into answering the same way all the time’.

Our participants also commented that they were bothered by nonsensical or illogical comparisons, such as a choice of one option that was better in every respect than the alternative. For instance, some participants were asked if they would prefer a treatment that cost $25 and produced little benefit or a treatment that cost $5 and yielded an increase in strength and well-being. This kind of comparison is a natural part of current ACA software, but it troubled our participants; one summed up her reaction with the comment, ‘It gave you options that weren’t really options sometimes’.

Discussion

Adaptive conjoint analysis is a flexible and powerful tool whose value in business has been well established. It has great promise as a technique to help patients make complex treatment decisions. We do not minimize the challenges to its implementation in the clinic, however, and our focus group results indicate the particular challenges of using ACA with the elderly.

Our participants agreed with the predicted preferred treatment about two-thirds of the time. This is roughly the result we expected – that the software will usually reverse-engineer the participant’s treatment preference based on preferred attributes, but that sometimes there will be a discordance between preferred attributes and chosen treatment. This discordance is potentially the key to showing a patient, ‘The treatment you choose may not be the best, given what you’ve told us about your concerns about effectiveness, side effects, and other considerations’.

Of the concerns our participants raised with the experience of using the software, only one, unfamiliarity with treatment attributes, was not clearly associated with our participants’ limited comfort level with computers. When participants hold fixed and erroneous beliefs about treatment attributes, as we observed with regard to exercise, it reduces the ability of the ACA paired comparison method and makes the summary evaluation of treatment options less reliable. Apart from this issue, every other problem our participants experienced appeared to be related to a greater or lesser extent to their unfamiliarity with computers. Our results, in other words, reflect the generational digital divide.

Our focus group participants do not view computers in the same way as their children and grandchildren; computers are not part of their daily – or hourly – life. At a time when tests administered by computer are increasingly used in the evaluation of young grade school children and teenagers participate in crowdsourced protein-folding research, older adults may consider themselves computer literate if they can play computer bridge and check their bank statement online. This literacy is distinctly limited. There is also the question of when an adult becomes ‘older’. Eshet-Alkalai and Chajut have studied differences in digital literacy over time, with ‘older participants’ who were between 30 and 40. Our participants were roughly twice that old.

We did not intend to explore the generational digital divide, and we made no attempt to quantify our participants’ computer literacy and comfort. In fact, we had naively assumed that if our participants could click a mouse to
choose between two treatment options, there would be no problem. The focus group comments show just how wrong we were. While we believe that computer discomfort, for which age is a reasonable proxy, was at work in our findings, we did not include the tools necessary to confirm this intuition, so we suggest that the interaction between age and complex or computerized decision aids may be fertile ground for others to investigate.

There is no easy solution to using unfamiliar decision aid software with older participants. Some people over 65 are very familiar with computers and would have no difficulty using ACA software. However, research limited to this computer-savvy group would yield results that would be useless in an ordinary medical clinic with more typical elderly patients.

The problem of limited elderly computer literacy can be mitigated by taking these considerations into account in future research. There is an inevitable, and sometimes painful, trade-off in the number of characteristics that can be included. More characteristics offer more choices but at the cost of confusion and increased program length. Additionally, participants are bothered when the program omits a choice they want, includes an option that they reject out of hand or presents a nonsensical or illogical choice. A partial solution may be to take more time upfront in developing and testing the program with participants who are representative of the actual sample population.

The clinical problem chosen should have a small number of treatment options. Fewer treatment options require the software to present fewer paired choices to complete the analysis. For participants for whom cost is not a major consideration, which was true for the Medicare-age participants in our sample, cost should not be included in the ACA.

A more extensive preparation for the ACA software should be attempted. Instead of an investigator demonstrating the use of ACA to purchase shoes, we suggest having the participants themselves use the shoe-purchase ACA program, so they can see for themselves how it works and how it feels. This would model how to proceed even when there is an imperfect match between the treatments the participant is interested in and the options presented by the software. Pieterse has shown that it is feasible to administer an ACA task over the internet, using an internet-based program would reduce travel and permit training and education to be spread over more than one session.

The goal in all of these is to make older patients more comfortable with the treatment choices, their attributes and the software with all of its seeming arbitrariness. The result should be increased reliability; Orme, as quoted in Hauser and Roa, has commented that confusion, difficulty and complexity lead to unsound results because they affect ‘the limits of how much information can be successfully evaluated before respondents either quit, glaze over or start to employ suboptimal methods for making choices’. The challenges participants experience with ACA, as others have pointed out, can impact study outcomes, which could lead to hesitation to use this type of software. To avoid this, researchers need to make ACA ‘doable for and acceptable to patients and to provide results that are helpful in decision-making processes’.

**Conclusion**

Our experience suggests that other researchers who use ACA, particularly with elderly participants, should pay particular attention to the number of treatments chosen and the attributes of those treatments. We suggest educating older participants about the apparent arbitrariness of some of the choices an ACA program will present and explaining in detail that the program requires a limited and unchanging choice of treatments and treatment attributes. Having participants perform an actual ACA on a simulated task, such as a purchase, would probably also help. Finally, to take advantage of incremental learning over time, this preparatory education could be undertaken online instead of in the clinical laboratory. These actions will help bring ACA’s power to today’s complex medical decisions.
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References


Appendix: 1 Description of attributes

This program will talk about your symptoms getting better by a small, moderate or big amount. Here is what we mean by these words.

Improvement in pain

Imagine that you have pain that keeps you from doing what you want to do every day. Then,

After a small improvement in pain, the pain still keeps you from doing what you want to do on most days.

After a moderate improvement, the pain is not bad enough to stop you from doing what you want to do most of the time.

After a big improvement, the pain is reduced enough that you can do what you want to do nearly all the time.

Day-to-day function

Imagine you have a lot of pain going up and down stairs.

If you have a small improvement in function, you can go up and down stairs a little easier, but it is still a struggle.

If you have a moderate improvement in function, getting up and down the stairs still takes work, but it is definitely easier than before.

If you have a big improvement in function, you can go up and down the stairs pretty easily.

Improvement in strength, energy and well-being

Imagine you have difficulty going shopping because of knee pain.

If you have a small improvement in strength, energy and well-being, you can go shopping but only for a very short period before you have to rest.

If you have a moderate improvement in strength, energy and well-being, going shopping is still tiring, but you can stay out for a longer time.
If you have a **big** improvement in strength, energy and well-being, you can go shopping long enough to get everything you need.

**Treatments**

- Pill taken from one to three times a day.
- Cream you put on your knees three times a day.
- Injection into your knee, up to four times a year.
- Exercises, like walking, riding a stationary bicycle, swimming or water exercise.

**Stomach Upset (presence vs. absence)**

This can include heartburn or mild nausea.

**Bleeding ulcer (presence vs. absence)**

Some medications can increase your risk of developing serious stomach side-effects including an ulcer or bleeding. This type of ulcer can happen without warning. Patients with a bleeding ulcer need to be admitted to the hospital and often will need blood transfusions.

**Cost of treatment**

- $5.00
- $10.00
- $25.00