Hedonic adaptation to treatment:

Evidence from a medical intervention

Abstract

We investigate whether changes in life circumstances lead to long-lasting changes in subjective well-being using a medical intervention that provided orthotic equipment to Ugandan adults with lower limb disabilities. The intervention had a positive effect on mobility and physical health, and treated patients reported a significant improvement in life satisfaction in the first few months after the treatment. However, the effect on subjective well-being was not prolonged. After one year, life satisfaction returned to the pre-treatment levels. The evidence of adaptation is also supported by evidence of changes in patients' reference levels, in the form of aspirations measured as both the level of income considered sufficient to live well, and the minimum income to make ends meet.

Keywords: Subjective well-being; adaptation; health; RCT; polio

1. Introduction

Recognition of the plight of people with disabilities in developing countries has recently come to the forefront of policy makers' agendas reflected in the United Nations 2015 Sustainable Development Goals. Whilst there is a growing literature documenting the economic status of this disadvantaged cohort (for an overview see Mitra, 2011), due to data limitations there is only a sparse literature on their subjective well-being (Fafchamps and Kebede, 2012). With access to data that measures the impact of a medical intervention, this paper investigates the relationship between changes to the physical health status of adults with physical disabilities in Uganda and their subsequent subjective well-being, focusing primarily on the phenomenon of hedonic adaptation.

Unlike existing cross-sectional studies of adaptation which have used data that cannot control for reverse causality or pre-change levels of subjective well-being, we treat the provision of medical equipment to individuals with a physical disability as an exogenous shock that could potentially cause a change in their quality of life and subjective well-being. Interviewing the patients before their treatment and then following up at four, ten and twelve months after treatment, we study the pattern of their life satisfaction and any potential adaptive process. We also link the study of adaptation to the analyses of aspirations, evaluating if and how aspirations have been affected by the treatment.

Adaptation can be defined as "*any action, process, or mechanism that reduces the effects of a constant or repeated stimulus*" (Frederick and Loewenstein, 1999). Psychologists were the first to identify its importance for individuals in diminishing the internal impact of external stimuli. For instance, persistent strong hedonic states, such as fear or stress, can have negative consequences on an individual's physical health. Adaptation can increase the awareness of one's status, and prevent the expenditure of energy in attempts to change something not changeable, and redirect motivation to feasible changes. Hedonic adaptation is thus seen to "*provide the serenity to accept the things one cannot change, the courage to change the things one can, and the wisdom to know the difference*" (Frederick and Loewenstein (1999)).

One of the first studies to model hedonic adaptation, Helson (1964), considered an individual's hedonic state as a function of the difference between the current stimulus level and the adaptation level, where the adaptation level is the average of past stimuli levels. Frederick and Loewenstein (1999) incorporated the importance of time in causing adaptive processes, claiming that more recent events may have a larger impact on adaptation than older events: adaptation level is a weighted average of past stimuli levels, with recently experienced stimuli receiving greater weight. Further modifications were developed, for example, the finding that the speed of adaptation is larger for gains than for losses (see e.g. Strahilevitz and Loewenstein, 1998); and that adaptation may depend on the anticipation of future stimulus levels ("feedforward"), that is, people may find it less difficult to adapt to a negative event if they knew about it in advance (see e.g. Van Praag, 1971). The fact that adaptation occurs for both bad and good events led Brickman and Campbell (1971) to develop the concept of the "hedonic treadmill", whereby people are constantly on a hedonic treadmill because of adaptive processes. Satisfaction for some events is only transitory, and eventually the individual becomes indifferent or even dissatisfied. The fact that people seem to return to a baseline level of satisfaction after adaptation to a certain event has led some authors, mainly in the psychological literature, to claim that people have a genetic "set point" of satisfaction, from which they can temporarily move but to which they return in the long-run (see e.g. Lykken and Tellegen, 1996).

However, despite evidence of this stability and heritability, there is also evidence that people do not adapt to certain events, even in the long-run. Life satisfaction can be permanently changed. Most of the results in the psychological literature are based on cross-sectional data which cannot measure individual change. More recent evidence from longitudinal studies shows instead that adaptation does not always occur. Fujita and Diener (2005) investigate the set-point theory using 17 years of German panel data (German Socio-Economic Panel - SOEP), and show that satisfaction does change over time and can remain different from a baseline, even in the long run. Lucas (2007) uses the German (SOEP) and British (British Household Panel Survey - BHPS) datasets and confirms that long-term levels of subjective well-being do change, but that the pattern of adaptation varies across both events and individuals. Examples of events to which people seem not to adapt, even in the long run, are widowhood (see e.g. Lucas, et al.,2003), unemployment (see e.g. Lucas, et al., 2004) and severe disability (Lucas, 2007).[1]

Disability is one of the most widely studied life events in the adaptation literature. Albrecht and Devlieger (1999) provide evidence of what they call the “disability paradox”. This refers to two findings: many people with a disability report to have a good or even excellent quality of life; yet non-disabled people predict a very low level of well-being for disabled individuals. A seminal paper on disability and subjective well-being by Brickman et al. (1978) compares the subjective well-being of lottery winners versus accident victims and finds that the latter are not significantly more dissatisfied than the former, which they explain in terms of adaptation. Similarly, in the psychological literature several works have shown that people with disabilities report quite high levels of subjective well-being and so conclude that people can and do adapt to events like the onset of a disability.

However, all of these studies, based on cross-sectional analysis, do not know the pre-change levels of subjective well-being. It is also the case that happiness or satisfaction levels reported by people with disabilities, despite being higher than that predicted by healthy people, are usually lower than that of healthy people. There is also a greater degree of discrepancy in cases of severe or multiple disabilities. Lucas (2007) explores the effect of long-term disability on subjective well-being using two longitudinal panel surveys (SOEP and BHPS) and finds that life satisfaction of long-term disabled people falls dramatically with the onset of the disability and remains significantly below the average for several years. A similar work in the economic literature by Oswald and Powdthavee (2008), again using the BHPS and SOEP datasets to study adaptation to disability, finds evidence of only partial adaptation (between 30% and 50% depending on the severity of disability).

Evidence for developing countries is scant. Despite the large number of interventions in developing countries, very little attention has been given to date to subjective well-being. Those that have looked at changes in life satisfaction have found medium term changes that are persistent. Haushofer and Shapiro (2013) use a RCT in Kenya to explore the effect of unconditional cash transfers on psychological well-being, finding that a reduction in poverty has significant positive effects on the recipients' satisfaction and happiness, and helps to reduce depression and levels of stress after one or two years. Cattaneo, et al. (2009) investigate the effect of a programme developed by the Mexican Government aimed at improving the living standards of people living in low-income neighbourhoods through the replacement of dirt floors with cement floors. After two-four years of the intervention the results show positive effects of the treatment on the people's satisfaction with their quality of life and a reduction of their levels of depression and stress. Devoto, et al. (2012) study the effect of household water connection in urban Morocco on overall household welfare. The water connection generated important time gains to the households treated, increasing their leisure and social activities. This was translated into an increase in their life satisfaction and perceived quality of life six months after the treatment.

Even less attention has been given to the relationship between disability and subjective well-being in developing countries. Fafchamps and Kebede's (2012) study using cross-sectional data in Ethiopia is the only paper to our knowledge. They do not find evidence of adaptation to disability which has a significant negative effect on life satisfaction irrespective of the time elapsed since the onset. Moreover, disability is also associated with a lower objective well-being which is shared by all the members of the household.

To summarize, the literature on hedonic adaptation suggests that after major events that initially increase or decrease subjective well-being, individuals tend to adapt to their condition over time, so that life satisfaction reverts to its pre-change level, or close to it in the case of partial adaptation (Helson, 1964, Parducci, 1968, Frederick and Loewenstein, 1999). Evidence from longitudinal studies shows for example that people adapt to changes in income (Clark et al., 2008, Di Tella et al., 2010), but not to events such as unemployment (Lucas et al., 2004) or poverty (Clark et al., 2016). The literature on adaption to changes in health has focused mainly on deteriorations in health conditions. Evidence here shows that people adapt to moderate disability but not to severe disability (Albrecht and Devlieger, 1999, Brickman et al., 1978, Lucas, 2007, Oswald and Powdthavee, 2008) or heart problems (Wu, 2001).

As discussed most of the evidence to date is non-experimental. As major events in life are often not exogenous, it has been difficult to infer causation using such survey data. It is also the case that the literature on disability and subjective well-being has tended to focus on negative health impacts on well-being. This paper adds to the literature by using a medical intervention in Uganda to study the effect of provision of orthotic equipment, which is expected to have a positive health change, on subjective well-being over time. We examine whether and to what extent individuals adapt to changes in their health; and analyze the potential driver of adaptation in the form of changes in patients' reference levels, namely aspirations.

The objective of the intervention implemented in 2012 and 2013 by a team of UK based economists and medical professionals, was to improve the mobility of Ugandan adults with lower limb disabilities by providing and fitting orthotic equipment. Following standard trial protocol, respondents were divided into a treatment and a control group. Both groups were medically assessed, interviewed and treated, although the control group were treated one year later. Using data collected at the baseline and three follow-up interviews at four, ten and twelve months after the treatment, we track the contemporaneous changes in medical conditions and subjective well-being of the patients and evaluate patterns of adaptation.

Our findings provide support for the adaptation hypothesis. The treatment has a positive impact on the patients' physical health and mobility. However, these effects are not translated into a long-lasting increase in life satisfaction. For the patients who are treated, life satisfaction significantly increases up to ten months after the treatment. After one year, life satisfaction returns to the baseline level despite the improvement in physical health.

We also investigate the possible channel of adaptation by measuring the aspirations of patients. Previous literature has explained adaptation in terms of changes in patients' aspirations, which serve as reference levels. Aspirations refer to the welfare needed to reach a certain level of subjective well-being and have a negative effect on well-being if not fulfilled (Gilboa and Schmeidler, 2001). When adaptation occurs, people adjust their aspirations to their new conditions which make them unsatisfied with their current state (Frederick and Loewenstein, 1999, Brickman and Campbell, 1971).

Our results provide evidence of changes in the patients' reference levels. In June 2012 we see that respondents in both the treatment and in the control group have the same level of aspirations. After one year, we observe an increase in the aspirations for the treatment group, as predicted by theory. According to the theories of adaptation when people adapt to their new conditions they adjust they aspirations accordingly; in the case of an improvement in well-being, adaptation should lead to an increase in aspirations. The finding supports the hypothesis that changes in reference levels are driving the adaptation process for our sample.

The rest of the paper is organised as follows: section 2 describes the medical intervention and the data. Section 3 reports the results of the medical impact of the intervention. The impact of the treatment on life satisfaction is discussed in Section 4. Section 5 contains robustness checks. Section 6 examines the channel of adaptation, i.e. the change in aspirations. Section 7 concludes.

2. Data and descriptives

The Uganda Polio Project aimed to help adult Ugandans affected by polio or other lower limb disabilities by providing them with medical equipment for their impairment. The intervention was implemented in June 2012 by a team of economists from The School of Economics of the University of Nottingham and medical professionals (neurologists, rehabilitation doctors, orthotists and orthotic technicians) from the Queens Medical Centre, Nottingham (part of the National Health Trust). [2] A large number of unused and second hand orthoses and assistive technology (for example, orthotic shoes, crutches, calipers) were donated by hospitals, orthotic manufacturers and individuals, and collected from around the UK and transported to Kampala, Uganda. The project was based in the Orthopedic Workshop, Old Mulago Hospital, Kampala.

From February to June 2012, potential candidates for the intervention were identified in collaboration with the University of Makerere and the two main disability charities in Uganda, the National Union of Disabled Persons of Uganda (NUDIPU) and Uganda National Action on Physical Disability (UNAPD). A snowball sampling method was used to draw up a list of names of individuals with lower-limb disabilities from NGO registers, health clinics and hospitals[3]. From the sampling frame, 200 patients were randomly selected to be assessed, fitted with the orthotic equipment and surveyed from day 1 to 9 of the intervention (treatment group). A further 100 subjects were invited to be assessed and surveyed from day 10 to 15 (control group), and were treated one year later[4].

The first wave which encompasses day 1-15 was the baseline (June 2012), when an extensive questionnaire collected information on the patients' socio-economic characteristics and a medical assessment measured their mobility and general health using both objective and subjective measures. Questionnaires were administered to participants in their local language by a team of trained enumerators from the University of Makerere. The next two waves of the project were telephone follow-up interviews with both the treated and controls, conducted four and ten months after the intervention using a scaled-down version of the baseline questionnaire and the same enumerators. The final wave of the project was in June 2013, one year after the baseline, when the entire team returned to Kampala, and all the patients who participated in the project were invited to Mulago hospital to be interviewed, reassessed (treatment), or treated (control). A detailed timeline of the project is provided in Table A1 in Appendix.

Our final sample consists of 236 observations observed in the first and last waves of the project and 197 observed in all four waves of the project (137 treatment cases and 60 controls).[5] The final sample differs from that planned due to two complications in the field: uninvited patients and attrition. The sampling strategy of the project had to be adjusted as word of mouth generated a torrent of hopeful people seeking to be treated. These uninvited patients were included in the project based on their compliance with the protocol set out by the medics for inclusion (namely having a lower limb disability and being of working age). Those that attended on days 1 to day 9 were assigned to the treatment group alongside the invited patients.[6] From day 10 onwards, uninvited patients were assigned to the control group: assessed and interviewed but not treated (until the following year). All participants were informed that they did not have to participate in the survey to receive treatment, and that they could terminate their involvement at any time.

Attrition arose due to the longitudinal nature of the project.[7] Although uninvited participants and attrition introduced an element of non-randomization into the project, we do not find significant differences between the treatment and control group in all the socio-economic characteristics and their baseline subjective well-being. The same holds for the baseline medical data (see the Supplementary Materials, Table S2). The analysis of attrition for all patients' characteristics reveals no differences between those who remained in the project and those who exited (see the Supplementary Materials, Table S3). In addition, randomization still holds after attrition for all the individual characteristics, with the only exception being length of disability (see the Supplementary Materials, Table S4). We show in section 5 that the main results of the paper are robust to the use of inverse probability weights to correct for attrition.

Table A3 in the Appendix contains the summary statistics at the baseline (Table S1 in the Supplementary Materials reports univariate frequencies of key variables). The average age of the sample is 40, with 59% of the sample being male. Most of the sample are married and in the labor market, the majority being self-employed. Average years of schooling is nine. The majority are disabled due to polio (65%); other sources of disability include road traffic accidents, infections, strokes and other diseases. For most patients, the onset of their disability occurred in childhood, with an average length of disability of 30 years.

2.1. Empirical strategy

Given the randomized nature of the intervention, our baseline empirical specification relies on the assumption that, without the treatment, the two groups would show parallel trends, so that the treatment can be estimated through a diff-in-diff analysis. However, as we have more than one follow-up period, in order to estimate the effect of the treatment in each of the three follow-up waves we interact the treatment dummy with the time dummies and estimate the following fixed-effects model:

$$(1)\quad Outcome_{it} = \alpha + \sum_{t=2}^{4} \beta_t T_i W_t + \sum_{t=2}^{4} \gamma_t W_t + f_i + \varepsilon_{it}$$

where T_i is a dummy for the treatment group, W_t are three time dummies (November 2012, April 2013 and June 2013, taking June 2012 as the omitted category), f_i are individual fixed-effects and ε_{it} is a residual error term. We estimate equation (1) through linear models.

Our second (and preferred) empirical specification corrects for the fact that part of the sample was not invited and was assigned to a treatment and control group on the basis of their date of arrival at the hospital.[8] A key feature of our estimation strategy is that the probability of being assigned to the control group was higher for patients who arrived towards the end of week two of the intervention due to lower availability of equipment and medical staff. In addition, patients who randomly arrived in week 3 were all assigned to the control group. For these non-invited patients, the probability of receiving the treatment depended on the date of arrival to the hospital. We solve this problem through an IV approach using the date of arrival to the clinic as the instrument for the treatment dummy. The date is directly linked to the probability of being treated, but not to the final outcome, that is medical measures and subjective well-being. We estimate the following 2SLS model:

$$(2)\quad Outcome_{it} = \alpha + \sum_{t=2}^{4} \beta_{it}\hat{T}_i W_t + \sum_{t=2}^{4} \gamma_t W_t + f_i + \varepsilon_{it}$$

Where $\hat{T}_i$ are the predicted values from the following first-stage regression:

$$T_i = \alpha + \delta_i Date_i + v_i$$

whereT_i is the treatment dummy and $Date_i$ is the date the patient arrived at the clinic.

The next section describes the impact of the intervention on the medical outcome, before exploring the effect on subjective well-being in section 4.

3. Impact on medical measures

The impact of the intervention on health was assessed using various patient-reported outcomes (PROs). Despite being based on patient’s own subjective evaluation of their condition, PROs are considered important for the evaluation of a medical treatment due to the difficulty in measuring conditions known only to the patients (for example, functional status). Given the nature of the medical treatment aimed at improving the physical functioning of adults affected by lower limb disabilities, we concentrate our analyses on measures of mobility and physical health.

Mobility was assessed using two questions from the World Health Organization Disability Assessment II (WHODAS II) questionnaire.[9] Patients were asked to indicate the difficulty they experience in: 1) standing for long periods such as 30 minutes and; 2) walking a long distance such as a kilometer. These two items produce a mobility component score which can be converted into a metric ranging from 0 to 100 (where 0 = no disability; 100 = full disability). The WHODAS II assessment was conducted in the first and last wave of the trial.

Physical health was assessed by adapting the Quality Metrics Short Form Health Survey (SF-8), which considers eight different components of health in the last four weeks (see Ware et al., 2001). Two questions were specifically related to physical health: one asked respondents to evaluate how much difficulty they have doing their daily work because of their physical health (physical functioning); the other asked how much their physical health problems limit usual physical activities (role limitations). They both score 0 to 100, with higher values indicating better physical health. This assessment was conducted in all the four waves.

Table I reports the estimates of the treatment effect on mobility at twelve months after the intervention (June 2013); and on physical functioning and role limitations at four, ten and twelve months (November 2012, April 2013 and June 2013). The table reports both the fixed-effect model and the IV specification. The results are robust to the type of specification we use and show a significant treatment effect on mobility (lower values indicate lower impairment) after one year (columns 1 and 4). Patients who received the orthotic treatment report between a 10 and 18 percentage-point reduction in the severity of their disability after one year compared to the control group, according to the fixed effects and IV models respectively. For physical health, we find a strong significant effect on both physical functioning and role limitations in April 2013, being equivalent to an 8.5 and 9.5 percentage point improvement respectively compared to the control group in the fixed-effects model (columns 2 and 3); the results of the IV model are qualitatively similar and larger in size (columns 5 and 6). We also observe a hump-shaped profile of health which corresponds to anecdotal evidence that patients took time to get used to using the equipment. However, in both specifications the effects on physical health, as reported by the patients, become insignificant after one year.

TABLE I ABOUT HERE

The finding that the effect on perceived physical health ceases to be significant after April 2013 can be due to a form of adaption similar to that discussed for subjective well-being. Empirical evidence within the dataset of objective health measures shows that improvements in clinical measures did not always correspond to improvements in the patients' own evaluation of their condition. The treatment itself could cause a response shift, that is, a change in the way the patient thinks about their health and functioning status (see for example, Schwartz et al., 2007, Schwartz et al., 2013). We explore this hypothesis by matching the changes in perceived mobility and physical health of treated patients with the improvement in their objective mobility. This was assessed by the medical doctors using an established locomotive measure, the time it takes a person to stand up from a chair, walk three meters, turn around, walk back and sit down (known as Timed Up and Go or TUG).[10] The faster a person can undertake the activity the less disabled they are. We therefore expect the TUG to decrease in cases where patient's mobility has improved.

We divide the treated patients into two groups: those who according to the TUG experienced an improvement in their mobility one year after the intervention, and those who did not. We define an improvement in mobility as a reduction from June 2012 to June 2013 in the time to perform the TUG task of at least 1.8 seconds, which corresponds to an effect size of 0.2 (20% of baseline standard deviation). [11]

Table II shows the mean changes from June 2012 to June 2013 in mobility and physical health according to their improvement in the TUG. Treated patients whose objective mobility improved also report a significant improvement in their perceived mobility. The effect sizes are not negligible, being 0.45 for the mobility component. For physical functioning and role limitations, however, the effect remains insignificant for those whose actual mobility improved, but is negative and significant for those whose mobility did not improve. The evidence that the treatment effect on perceived physical health is insignificant after one year, even for those whose mobility improved, may suggest that this indicator is more affected by response shifts than the more direct WHODAS II mobility measure, which seems to correspond better to changes in objective measures.

TABLE II ABOUT HERE

In the next section we analyze our main research question, i.e. the impact of the treatment on life satisfaction over time.

4. Impact on life satisfaction

We measure subjective well-being through a life satisfaction question which asks the respondents to score the following statement "I am satisfied with my life" on a 7-pt scale (1=strongly disagree, 7=strongly agree). Before the treatment both treated and control patients report very low levels of satisfaction. In June 2012, the mean value of life satisfaction is 3.4 and the mode is 2 (reported by a third of the sample). This average level of satisfaction is much lower than western countries (where it is usually higher than 5), but not much lower than the national mean (3.9)[12] and the mean of a sample of non-disabled people surveyed in Kampala (3.9)[13]. Figure 1 shows the pattern of mean life satisfaction for the treatment and control group over time, for the balanced sample (N=197). Four months after the intervention, life satisfaction is markedly higher for the treatment group, with a mean score of over 3.8 compared to the baseline level of 3.3. However, this gain is not maintained, eroding slightly by the second follow-up in April 2013. One year after the intervention, in June 2013, life satisfaction has returned to the original level and is similar to that reported by the control group.

FIGURE 1 ABOUT HERE

Although the initial rise in life satisfaction for the treated group is statistically significant compared to the baseline level (t-test, p-value=0.002 and p-value=0.011 for November 2012 and April 2013 respectively), the diff-in-diff estimate is insignificant. One possible explanation for the lack of significance is that life satisfaction initially increased (although not significantly) for the control group. For ethical reasons, the patients in the control group were informed that they would be treated in the following year. As current expectations have a positive effect on subjective well-being as anticipatory emotions (see Loewenstein, 1987, Caplin and Leahy, 2001), the increase in life satisfaction for the control group may reflect the effect of participating in the program and the expectations derived from this[14]. For this reason, our estimation can be seen as a lower bound for the treatment effect on life satisfaction.

Given that half of the sample reports very low levels of life satisfaction in the baseline (that is report values of one or two on the 7-point scale), we focus our analyses on the probability of such low reports. Specifically, we create a dummy variable (LS) for life satisfaction being three or higher:

$$LS_{i=}\begin{cases}1 & if\ Life\ Satisfaction \geq 3\\ 0 & else\end{cases}$$

We estimate equations (1) and (2) using the dummy for life satisfaction as the dependent variable. Table III reports the estimates of the linear probability models.[15] Despite the positive effects we found on perceived mobility and physical health, we do not find the same changes in life satisfaction over the period of the trial. The coefficients are in the right direction, being positive and decreasing over time, but are all insignificant in the FE model. The treatment effect appears instead large and significant in the IV model which corrects for the non-random component of the sample. The instrument is significant and not weak, and we see from the first-stage regression that the date of arrival at the hospital has a negative effect on the probability of being treated, as explained in section 2. Yet, even in the IV model the treatment effect is significant only in November 2012. In the following periods, the effect becomes insignificant and smaller in size. The pattern of life satisfaction, first rising after the treatment and then falling, is consistent with the hypothesis of adaptation.

TABLE III ABOUR HERE

5. **Robustness** checks

As we mentioned in the project description, the sample suffers from attrition, which was especially pronounced in the last of the four waves. Despite the finding that attrition does not depend on observable characteristics of the patients, it is a concern that we do not have information on the medical conditions and subjective well-being of the patients who dropped out of the project. It could be the case that these patients exited the sample for reasons which are independent of the project, causing random attrition. It may also be the case, however, that some patients exited the project because the treatment was successful and so their perception was they did not need any further medical care; or, vice versa, because the treatment failed or they were disappointed by the outcomes and were not willing to participate further. All these elements could generate non-random attrition affecting our estimations.

To address this concern, we replicate the estimates using four alternative models that deal with attrition. First, we estimate equation (1) and (2) on the balanced sample correcting the estimates using inverse probability weights. We use baseline information to predict the probability of remaining in the sample in all the waves, and correct the fixed-effect estimates using inverse probability weights, calculated as the inverse of the predicted probabilities ($1/p$). The variables we use to predict attrition are gender, marital status, job status, years of schooling, household size, severity of disability, and length of disability.

Second, we run the regressions on the unbalanced sample composed of patients for whom we have information in at least one follow-up (N=314). Third, using again the unbalanced sample of 314 observations, we replace the missing values for life satisfaction carrying forward the last available information from the follow-up surveys.

Fourth, we run an intention-to-treat analysis where we assign to the non-compliers, whose outcomes are not observed, a best and a worst case scenario.[16] Namely, for the patients who are not observed in all the waves, we replace the missing values of life satisfaction with the best possible value (1, that is life satisfaction equal to or higher than 3) and with the worst value (zero, a very low level of satisfaction). In the case of the best scenario, we assign a value of 1 to the non-compliers belonging to the treatment group, and 0 to those in the control group, assuming that the control patients should not experience any improvement in absence of treatment. In the case of the worse scenario, we assign a value of zero to both groups. The ITT analyses are based on the full sample (N=354).

The results of the robustness checks broadly confirm our previous finding (Table IV). Across all estimations we find a significant positive effect in November 2012 in the IV specification (columns 6 to 10), while no effect in the reduced model in the first three specifications (columns 1 to 3). For the ITT models which are based on the entire sample of 354 observations we find in the worst scenario a positive but decreasing effect of the treatment on life satisfaction, now significant in November 2012 even in the FE model (column 4). In the best scenario we find significant effects in all the waves, with the largest coefficient in June 2013 (column 5). This finding may be driven by the large number of missing values replaced in the last wave where attrition was the most severe. However, notice that in the IV estimates we still find evidence of adaptation even in the best scenario, as the size of the coefficients is decreasing over time (column 10).

TABLE IV ABOUT HERE

6. Changes in patients’ reference levels: aspirations

In this section we examine aspirations to identify the channel of adaptation. Accounts of the process of adaptation frequently refer to changes in people's reference levels. The medical treatment provided by the intervention could change the patients’ reference levels by raising their aspirations in the long run if the treatment is successful, and patients adapt to their new conditions. Aspirations and adaptation will depend on the treatment effect. If patients experience an improvement in their mobility and health, the expectation is that their life satisfaction will increase in the short-run. However, in the medium/long-run, if adaptation occurs, and their aspirations shift, they will no longer be satisfied with their new condition, and could experience a decrease in their subjective well-being.

In the survey, questions on aspirations were asked with respect to levels of income. Following the previous empirical literature (see Stutzer, 2004; Knight and Gunatilaka, 2012; Barr and Clark, 2010) we measured income aspirations as both the level of income considered sufficient to live well, and the minimum income to make ends meet. The expectation is that if there is an improvement in health this could lead to future job opportunities and improvements in life conditions that could impact on income aspirations. From the literature we know that disability is often associated with a significant income cost. Meyer, Wallace and Mok (2019) estimate adult disability lowers the earnings of elderly male heads in the US by around 77% after 10 years from the onset of disability. In Uganda, the corresponding beneficial impacts of the orthotic treatment are unlikely to be as large, but still might be expected to be significant. For example, Bridges, Owens and Gaggero (2015) using the medical intervention data, find that the treatment increased labour force participation and earnings of the treated.

Both variables are ordinal taking five values of household income per month. The range of possible answers goes from less than 50,000 UGX (about $19) to more than 200,000 UGX (about $76). For these two variables, we have information at the baseline (June 2012) and at 12 months after the intervention (June 2013). The treated and controls do not differ at the baseline in their income aspirations (Tables S1 and S3 in the Supplementary Materials), so we can perform a simple diff-in-diff estimation in order to estimate the effect of the treatment on these variables for the two groups in the two waves (Table V).

Our results suggest that the treatment effect had an impact, even if small, on patients' aspirations: after one year from the intervention we observe an increase for the treatment group for both measures of income aspirations, with a significant impact on the minimum income measure. According to the theories of adaptation when people adapt to their new conditions they adjust they aspirations accordingly; in the case of an improvement in well-being, adaptation should lead to an increase in aspirations. The increase in aspirations for the treatment group is significant at 10% level.[17]

TABLE V ABOUT HERE

7. Conclusions

Using a medical intervention in Uganda, we evaluated the effect of provision of orthotic equipment on subjective well-being for a sample of adults with physical disabilities. All the patients participating in the project had lower limb disabilities, mostly due to polio. The treated sample was provided with orthotic technology for their disability. An extensive questionnaire and a medical assessment were conducted at the beginning of the project in order to collect baseline data on the patients before the treatment. Follow-up data were collected through two telephone interviews using a scaled-down version of the questionnaire

(November 2012 and April 2013) and again in person in June 2013, when the control group was treated and the treatment group reassessed.

The impact evaluation showed that the treatment had a positive effect on patients' physical health, significantly increasing their mobility one year later compared to the control group as measured by the WHODAS II mobility measure. Also, compared to the controls, we found that the treatment significantly improved the patients' perceived physical functioning and role limitations ten months after the intervention. We do find however, that after 12 months these perceived variables are no longer significant, even for those whose objective measure of mobility had improved. This suggests these indicators may be more affected by response shifts than the more direct WHODAS II mobility measure, which seems to correspond better to changes in objective measures.

Exploring the effect of the treatment on life satisfaction we find that treated patients experienced an increase in their life satisfaction in the first four months following the intervention, but the effect is not lasting. After one year the level of the life satisfaction returned to the same level as that reported in the baseline, and was not different from the level of the control group. These findings suggest that positive health changes may lead to only temporary increases in subjective wellbeing, and that the patients quickly adapt to their new conditions.

The evidence of adaptation is also supported by the analysis of reference levels. Aspirations for the treated and control groups were not statistically different at the baseline, but we find that after one year, aspirations, as measured as the minimum level of income to make ends meet, significantly increased for the treatment group compared to the control group.

To the best of our knowledge, this study is the first attempt to explore the phenomenon of hedonic adaptation in adults with disabilities in the context of a medical intervention. We acknowledge that more research is needed to understand the impact of health interventions on individual subjective well-being. We identify two particular areas that need further investigation. First, if individuals are more sensitive to losses than gains, it could be that positive changes in health weigh less than negative changes. Future work should study the prospective changes in subjective well-being after medical treatments that have a large impact on patients' health and quality of life. Second, it could be that different ways of treating disability have different impacts on the outcome. Our treatment focuses mainly on the physical component of disability through the provision of orthotic equipment. Treatments that combine physical assistance with rehabilitation or psychological programs may have a different effect on patients' subjective well-being and adaptive processes.

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[1] Diener, Lucas et al. (2006) provide a detailed discussion about set-point theory and its critiques.

[2] Ethical approval was granted by both the University of Nottingham and the Uganda National Council for Science and Technology, June 2012, reference SS 2781.

[3] In consultation with the orthotists and medical doctors at the beginning of the project we deliberately chose a type of disability that is stable and comparable across patients and time. We focus on lower limb disabilities that were incurred on average 30 years prior to the study.

[4] In consultation with the collaborating NGOs we planned a bigger treatment group than control group so more benefits could be provided earlier. We transported a 40 foot container of medical equipment; followed by medical staff from the UK. The orthotists' over riding aim was making as big a difference as possible to people's lives.

[5] At the baseline (June 2012) our sample is composed of 370 patients: 245 in the treatment group and 125 in control group. From these we had to exclude 16 patients from the analyses because their medical conditions were considered too severe to be treated with an orthotic intervention (e.g. amputee), leaving a total number of 354 observations. These patients were interviewed and received medical attention (e.g. physiotherapy, wheelchair). Due to attrition, our final sample consists of 236 observations available in the first and last waves and 197 in all the four waves (137 treatment cases and 60 controls).

[6] Exceptions included cases where the equipment required was not available. In this case (45 instances) uninvited patients were included in the study as controls.

[7] Attrition was an issue mainly in the last wave of data collection due to a transport strike in Kampala.

[8] Running the estimations on the invited only sample reduces the sample size considerably. The sign and size of the coefficients are in the same direction but due to the small number of observations we lose significance.

[9] See http://www.who.int/classifications/icf/whodasii/en/

[10] Unfortunately for the control group this measure was collected only after their treatment in June 2013 thus ruling out the possibility of performing diff-in-diff estimations.

[11] Effect size is computed as standardized mean change (Cohen's d).

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[12] Source: World Database of Happiness. The value 3.9 is obtained normalizing the original value 4.8 from a 0-10 points scale to the 1-7 point scale. The data refer to the average of two surveys conducted in 2000 and 2009.

[13] Data on non-disabled people was collected in June 2013 via a mini survey conducted in the streets of Kampala by the authors. The sample is composed of 240 observations.

[14] An alternative explanation is there may have been a population wide improvement in life satisfaction in Uganda that year. Data on Ugandan's happiness index does not support this. In 2012 the World Happiness Report documents Ugandan's happiness index at 4.5; in 2013 it was 4.4. (http://worldhappiness.report). The nature of diff-in-diff estimators is to control for such macro changes (e.g. our life satisfaction model includes a dummy for time) and we focus subsequent analysis on where diff-in-diff effects were found to be significant.

[15] Estimates using logit models produce qualitatively similar results and are available upon request.

[16] Following Hollis and Campbell (1999) we present ITT results for completeness. This method, which involves imputing missing satisfaction observations with best and worst case outcomes, allows us to band the results. However, given the missing observations are in the last wave by inputting high satisfaction for this wave by construction we do not find adaptation in the best case scenario.

[17] When we use the sample balanced only in the first and last wave (N=236), the increase in aspirations from June 2012 to June 2013 is even more significant (p=0.016).

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TABLES

Table I - Treatment effect on patient-reported outcomes

	FE models			IV models		
	Mobility[(a)] (1)	Physical functioning[(b)] (2)	Role limitations[(b)] (3)	Mobility[(a)] (4)	Physical functioning[(b)] (5)	Role limitations[(b)] (6)
Treat*Nov '12	-	3.90	4.12	-	8.15	9.29
		(3.94)	(4.06)		(5.99)	(6.07)
Treat*Apr '13	-	8.44^{**}	9.59^{***}	-	10.94^{*}	13.86^{**}
		(3.82)	(3.63)		(5.74)	(5.72)
Treat*Jun '13	-10.02^{**}	4.83	3.66	-18.77^{***}	3.48	2.88
	(4.71)	(4.13)	(3.94)	(7.00)	(5.93)	(5.88)
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
N	364	759	760	336	746	747
R^2	0.03	0.06	0.03	0.01	0.05	0.02
F-stat	-	-	-	370.64	118.74	118.80
Endogen. test	-	-	-	0.09	0.51	0.32

*Notes: Omitted category: June 2012. Standard errors in parenthesis. *p<0.10 **p<0.05 ***p<0.01. (a) WHODAS II measured in first and last wave only: mobility is a metric ranging from 0 to 100 (where 0 = no disability; 100 = full disability), thus negative numbers show an improvement in mobility. (b) SF-8 measured in all four waves: physical functioning and role limitations both score 0 to 100, with higher values indicating better physical health. Last row report p-values of endogeneity test. Table S5 in the Supplementary Materials reports the sample sizes available for each measure.*

Table II – Mean change in patient-reported outcomes according to improvement in objective mobility (TUG) from June 2012 to June 2013.

	Mobility improved		**Mobility not improved**	
Mobility(a)	-13.49**	*(6.75)*	1.02	*(4.51)*
Physical functioning(b)	1.08	*(5.11)*	-8.95**	*(3.51)*
Role limitations(b)	4.87	*(5.61)*	-4.03	*(3.36)*

*Notes: asterisks refer to significant levels of t-test. *p<0.10 **p<0.05 ***p<0.01. Data refer to treatment group only. Standard errors in parenthesis. (a) WHODAS II; (b) SF-8.*

Table III - Effect of treatment on life satisfaction

	FE model	**IV model**
Treatment effect in Nov 2012	0.136	0.268**
	(0.0985)	(0.1354)
Treatment effect in Apr 2013	0.095	0.104
	(0.0965)	(0.1332)
Treatment effect in Jun 2013	0.081	-0.004
	(0.1008)	(0.1508)
Time effects	Yes	Yes
Individual FE	Yes	Yes
Instrument:		
Date of arrival to clinic	-	*-0.087****
N	786	770
R^2	0.14	0.13
F-stat	-	120.13
Endogen. test (p-value)	-	0.17

*Notes: Coefficients reported with standard errors in parentheses. Omitted category: June 2012. *p<0.10 **p<0.05 ***p<0.01.*

Table IV – Intention-to-Treat analysis and other robustness checks

	FE models					IV models				
	Balanced sample - IPWs (1)	Unbalanced sample (2)	Carryforward (3)	Worst scenario (4)	Best scenario (5)	Balanced sample - IPWs (6)	Unbalanced sample (7)	Carryforward (8)	Worst scenario (9)	Best scenario (10)
Treat*Nov '12	0.125	0.091	0.110	0.146*	0.340***	0.241*	0.213*	0.245**	0.315***	0.447***
	(0.1032)	(0.0801)	(0.0723)	(0.0767)	(0.0741)	(0.1339)	(0.1202)	(0.1098)	(0.1130)	(0.1042)
Treat*Apr '13	0.094	0.094	0.097	0.116	0.326***	0.058	0.047	0.098	0.198*	0.348***
	(0.1025)	(0.0788)	(0.0738)	(0.0738)	(0.0705)	(0.1348)	(0.1202)	(0.1065)	(0.1100)	(0.1033)
Treat*Jun '13	0.082	0.047	0.075	0.062	0.402***	-0.061	-0.096	0.000	0.073	0.372***
	(0.0991)	(0.0879)	(0.0786)	(0.0757)	(0.0747)	(0.1516)	(0.1442)	(0.1217)	(0.1195)	(0.1148)
Time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	786	1095	1255	1415	1415	786	1095	1219	1379	1379
R^2	0.14	0.13	0.10	0.08	0.12	0.13	0.12	0.09	0.08	0.13
F-stat	-	-	-	-	-	127.66	89.56	124.90	150.81	150.81
Endogen. test	-	-	-	-	-	0.11	0.06	0.07	0.20	0.29

*Notes: Dependent variable: Dummy for life satisfaction>=3. Omitted category: June 2012. Standard errors in parenthesis. *p<0.10 **p<0.05 ***p<0.01. P-value reported for the endogeneity test in the IV models.*

Table V – Diff-in-diff estimation of treatment effect on income aspirations

	June 2012			June 2013			June 2012 - June 2013	
	Treatment	Control	Diff	Treatment	Control	Diff	Diff-in-Diff	P-value
Sufficient income	4.60	4.72	-0.11	4.72	4.59	0.13	0.24	0.12
Minimum income	4.16	4.27	-0.11	4.21	3.88	0.33	0.43	0.08*

*Notes: *p<0.10 **p<0.05 ***p<0.01.*

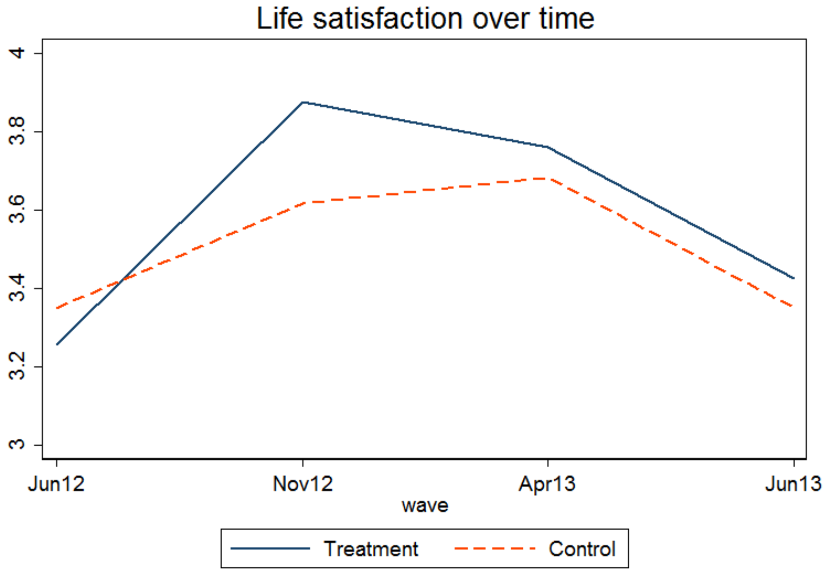
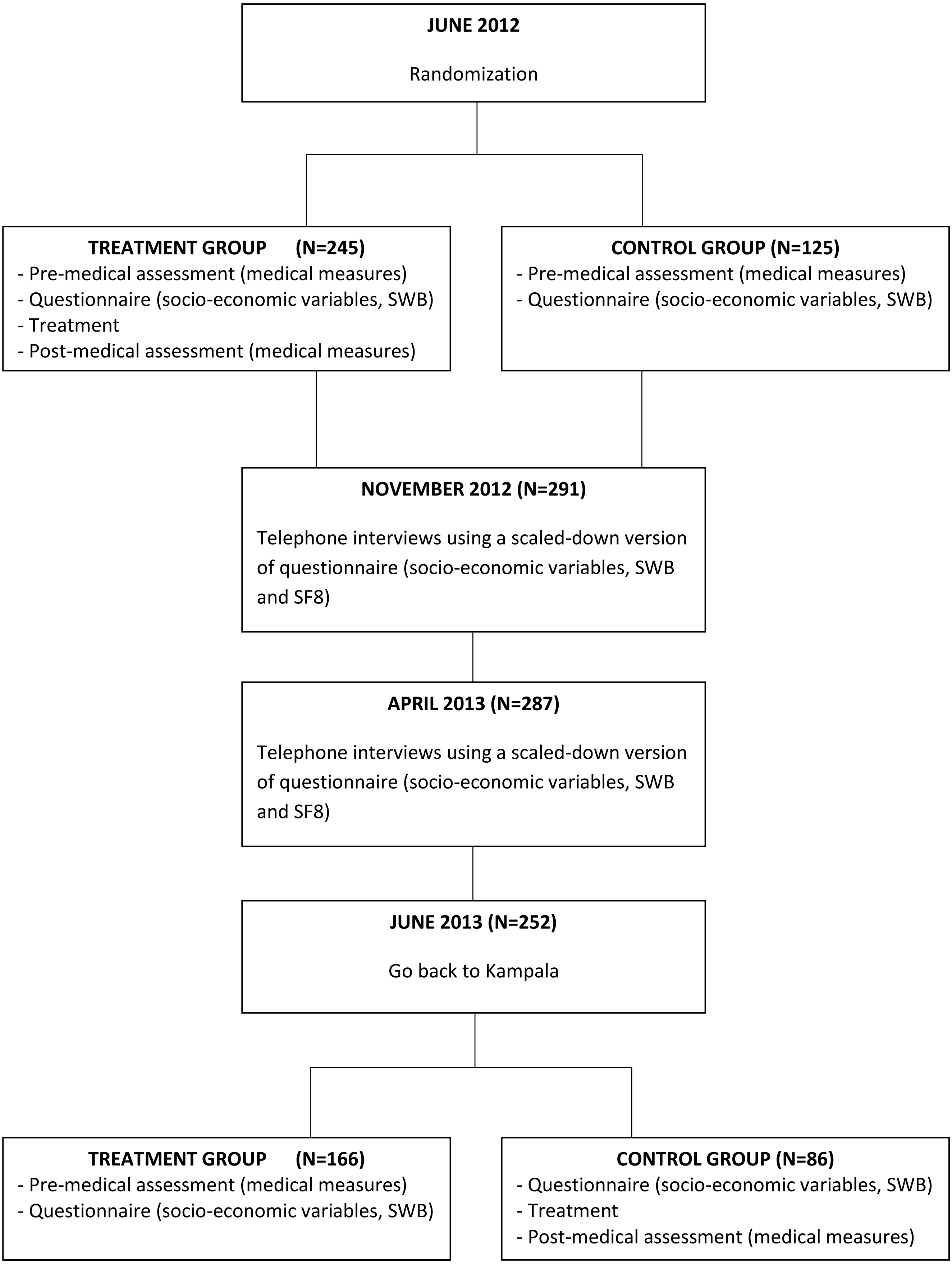


Figure 1 – Life satisfaction over time by treatment and control group

Appendix

Table A1 - Timeline of the project



JUNE 2012

Randomization

TREATMENT GROUP (N=245)
- Pre-medical assessment (medical measures)
- Questionnaire (socio-economic variables, SWB)
- Treatment
- Post-medical assessment (medical measures)

CONTROL GROUP (N=125)
- Pre-medical assessment (medical measures)
- Questionnaire (socio-economic variables, SWB)

NOVEMBER 2012 (N=291)

Telephone interviews using a scaled-down version of questionnaire (socio-economic variables, SWB and SF8)

APRIL 2013 (N=287)

Telephone interviews using a scaled-down version of questionnaire (socio-economic variables, SWB and SF8)

JUNE 2013 (N=252)

Go back to Kampala

TREATMENT GROUP (N=166)
- Pre-medical assessment (medical measures)
- Questionnaire (socio-economic variables, SWB)

CONTROL GROUP (N=86)
- Questionnaire (socio-economic variables, SWB)
- Treatment
- Post-medical assessment (medical measures)

Table A2 Definition of variables

Life satisfaction	Measures subjective well-being through a life satisfaction question which asks the respondents to score the following statement “I am satisfied with my life” on a 7-pt scale (1=strongly disagree, 7=strongly agree).
Mobility	Mobility was assessed using two questions from the World Health Organization Disability Assessment II (WHODAS II) questionnaire. Patients were asked to indicate the difficulty they experience in: 1) standing for long periods such as 30 minutes and; 2) walking a long distance such as a kilometre. These two items produce a mobility component score which can be converted into a metric ranging from 0 to 100 (where 0 = no disability; 100 = full disability). The WHODAS II assessment was conducted in the first and last wave of the trial.
Physical functioning	Patients were asked to evaluate how much difficulty they have doing their daily work because of their physical health. They were scored 0-100 with higher values indicating better physical health. This assessment was conducted in all the four waves.
Role limitations	Patients were asked how much their physical health problems limit usual physical activities. They were scored 0 to 100, with higher values indicating better physical health. This assessment was conducted in all the four waves.
Timed Up and Go	Established locomotive measure. Measures the time it takes a person to stand up from a chair, walk three meters, turn around, walk back and sit down (known as Timed Up and Go or TUG).
Income aspirations	Measured as both the level of income considered sufficient to live well and the minimum income to make ends meet. They are both ordinal variables taking five values of household income per month. The range of possible answers goes from less than 50,000 UGX (about $19) to more than 200,000 UGX (about $76). For these two variables, we have information at the baseline (June 2012) and at 12 months after the intervention (June 2013).

Table A3 – Summary statistics in June 2012

Variable	mean	sd	min	max
Socio-economic characteristics				
Age	40.5	12.8	14	82
Years of schooling	8.9	4.1	0	16
HH income	170577	101614	25000	282622
Job status	2	0.7	1	3
Marital status	2.9	1.8	1	6
HH size	5.1	2.4	1	12
No. children	2.2	2.0	0	9
Medical data				
Timed Up and Go	13.1	7.9	3.1	87
Mobility	56.1	29.1	0	100
Physical functioning	66.0	21.3	20	100
Role limitations	67.9	21.6	20	100
Length of disability	29.6	16	0	73.3
Subjective well-being				
Life satisfaction	3.4	1.9	1	7
Aspirations and expectations				
Sufficient income	4.6	0.8	1	5
Minimum income	4.2	1.1	1	5