




Benefit finding in renal transplantation and its association with psychological and clinical correlates: A prospective study

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Objectives. The identification of positive psychological changes, including benefit finding (BF), in chronic illness has gained substantial interest. However, less is known about BF in the context of a positive medical intervention. End-stage renal disease (ESRD) can be regarded as a burdensome condition, but transplantation is expected to restore physical and psychological functioning to a large extent after a period of illness. The aim of this study was to examine (1) changes in BF from pre- to 12 months post-transplantation, (2) the concurrent association of disease-related characteristics and optimism to BF, and (3) the potential causal relations between BF and distress.

Methods. In this longitudinal study, 319 patients completed questionnaires before, 3 months, 6 months, and/or 12 months post-transplantation. Multilevel models were used for the analyses. Measures included the Illness Cognitions Questionnaire to measure BF, the Life Orientation Test to measure optimism, and the General Health Questionnaire to measure distress.

Results. Benefit finding increased from pre- to post-transplantation. Fewer symptoms and comorbidities, and more optimism, were related to more BF over all time-points. The direction of the relation between BF and distress changed over time. Before transplantation, distress predicted an increase in BF, whereas post-transplantation,

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distress predicted a decrease in BF. The causal relation between BF and distress post-transplantation appeared to be reciprocal.

Conclusions. A positive medical intervention such as renal transplantation might facilitate the development of BF. This study indicates the need for longitudinal research on the relation between BF and psychological health in the face of positive events.

Statement of contribution

What is already known on this subject?

- Benefit finding refers to the identification of positive psychological changes following a negative life event.
- Individuals can experience benefit finding following chronic illness.
- The positive event of kidney transplantation is associated with improvements in patients' physical and psychological functioning.

What does this study add?

- Benefit finding increases from pre- to post-kidney transplantation.
- Fewer symptoms and comorbidities, and higher optimism are related to more benefit finding.
- Before transplantation, distress predicts an increase in benefit finding.
- After transplantation, there appears to be a reciprocal relation between distress and benefit finding such that distress predicts a decrease in benefit finding and benefit finding predicts a decrease in distress.

The potential for positive psychological changes following a negative event, such as chronic illness, has gained substantial attention. These changes have, however, never been studied before and after a positive medical intervention following a period of severe illness. The current prospective study addresses this topic by examining benefit finding (BF) from pre- to post-renal transplantation in patients with end-stage renal disease (ESRD).

A variety of terms have been used to identify positive changes following illness, including post-traumatic growth (Tedeschi & Calhoun, 1996, 2004), stress-related growth (Park & Helgeson, 2006), and benefit finding (BF; Affleck & Tennen, 1996). This article uses the term of benefit finding, because we view the positive changes broadly. BF can be manifested in many ways, including a greater appreciation for life, an increase in personal strength, and perceiving that one has learned a lot from one's illness (Evers *et al.*, 2001). Benefit finding has been reported across a wide range of illnesses and health problems, including cancer (Danhauser *et al.*, 2013a,b; Koutrouli, Anagnostopoulos, & Potamianos, 2012), HIV (Milam, 2004), and spinal cord injury (January, Zembracki, Chlan, & Vogel, 2015). These studies show that when individuals are confronted with a severe health threat, some people are able to construe benefits. BF has not been examined before and after a medical intervention assumed to alleviate physical and psychological suffering following a period of severe illness. The event of renal transplantation in the context of end-stage renal disease (ESRD) provides such an opportunity.

The increasing prevalence of ESRD is posing a worldwide health problem, with an increased need of life-sustaining renal replacement therapy, including dialysis or kidney transplantation. ESRD, and particularly dialysis, can impose physical and psychological challenges for patients, such as itching, extreme fatigue, and difficulties fulfilling family and social roles (Ekelund & Andersson, 2010; Karamanidou, Weinman, & Horne, 2014). Transplantation is associated with a better quality of life and higher life expectancy compared to dialysis (Landreneau, Lee, & Landreneau, 2010; Li *et al.*, 2017; Tonelli *et al.*, 2011). Renal transplantation involves a major surgery and does not provide a complete

cure for ESRD. In fact, levels of well-being and quality of life after transplantation remain lower compared to that of the general population (Karam *et al.*, 2003; Weber *et al.*, 2014). However, transplantation has consistently been associated with improvements in physical functioning, well-being, and overall quality of life (Dontje *et al.*, 2014; Tavallaii & Lankarani, 2005; Tonelli *et al.*, 2011; von der Lippe *et al.*, 2014). Moreover, qualitative research has shown that kidney recipients perceive the transplant as a chance to live a new and better life (Buldukoglu *et al.*, 2005; Schipper *et al.*, 2014). Therefore, transplantation is referred to as a positive medical intervention throughout this paper. Existing studies on BF in transplantation have primarily focused on the period post-transplantation (Fox *et al.*, 2014; Scignaro *et al.*, 2016; Segatto, Sabiston, Harvey, & Bloom, 2013; Widows, Jacobsen, Booth-Jones, & Fields, 2005). This is the first study examining whether renal transplantation is related to an increase or decrease in BF.

There might be certain individuals who are more or less likely to experience BF. Therefore, a second study aim was to examine whether a set of disease-related and personality variables are related to BF across transplantation. Importantly, studies on the association between these variables and BF have been conducted among patients during the course of a severe health threat. It is therefore not known how disease-related and personality characteristics influence BF in the event of a positive medical intervention. Important disease-related characteristics that have been examined in connection with BF are the *time* passed since the onset of the event and *disease severity*. According to the theory of post-traumatic growth (Tedeschi & Calhoun, 2004), BF takes time to develop. Thus, BF may be more pronounced among patients who have had more time to process the diagnosis of an illness compared to patients who are in the period proximal to the event, when feelings of distress predominate and patients first need to adapt to a dramatic life change. However, findings regarding the relation between time since diagnosis and BF are inconsistent (Barskova & Oesterreich, 2009; Shand, Cowlshaw, Brooker, Burney, & Ricciardelli, 2015), with some studies showing that more time passed since the diagnosis of an illness was related to more BF, and some studies showing null-findings (Helgeson, Reynolds, & Tomich, 2006).

Disease severity is an important variable to examine in conjunction with BF, given that a stressful event is a prerequisite for BF to arise and more stressful life experiences are expected to lead to more BF (McFarland & Alvaro, 2000; Tedeschi & Calhoun, 1996, 2004). Results on the relation between disease severity and BF are not completely clear. According to a meta-analytic review, BF was associated with more severe traumatic events (Helgeson *et al.*, 2006). However, in a longitudinal study of people with cancer undergoing bone marrow transplantation, BF was unrelated to progression of disease or risk of recurrence (Widows *et al.*, 2005).

Regarding personality characteristics, a frequently studied construct in connection with BF is *optimism*. There is consistent evidence that optimism is related to more BF (Dunn, Occhipinti, Campbell, Ferguson, & Chambers, 2011; Helgeson *et al.*, 2006; Pascoe & Edvardsson, 2013; Prati & Pietrantonio, 2009; Zoellner & Maercker, 2006). Dispositional optimism refers to a stable trait where people hold general favourable expectancies that good rather than bad things will happen to them (Scheier & Carver, 1985).

Lastly, a much-debated question in the literature on BF concerns its relation to psychological health, specifically whether BF is positively, negatively, or unrelated to indicators of psychological health. Literature findings concerning this issue are inconsistent (Barskova & Oesterreich, 2009; Helgeson *et al.*, 2006; Koutrouli *et al.*, 2012; Pascoe & Edvardsson, 2013). For example, in a meta-analytic review of cross-sectional studies,

Helgeson *et al.* (2006) did not find a relation between BF and measures of distress, anxiety, or quality of life, but found a relation between BF and lower depression. In a systematic review and meta-analysis among people with cancer, there was a weak but statistically significant association between BF and lower depression and between BF and lower distress, but no relation of BF to anxiety (Shand *et al.*, 2015). The prospective nature of the present study provides more insight into the potential causal relation between BF and distress among patients with ESRD. Thus, we have the opportunity to examine whether BF is associated with distress on a subsequent time-point, whether distress is associated with BF on a subsequent time-point, or whether the relation is reciprocal.

The present prospective study consisted of three study aims. First, we examined whether BF changed from pre- to 12 months post-transplantation. Because this is the first prospective study examining BF in the context of a positive medical intervention, no specific hypothesis was offered. Second, we examined the concurrent associations of disease-related characteristics and optimism to BF over time. Based on the BF theory, we predicted that indicators of disease severity, such as more symptoms and comorbidities, would be related to higher BF. According to previous research, we predicted that more optimism would be related to higher BF. The relation between time on dialysis pre-transplantation and BF was also examined. As it is not clear how time on dialysis might affect BF, we did not have a prediction for this research question. Finally, we examined the potential causal relations between BF and distress. Because the direction of this relation is not clear, there is no hypothesis regarding this last research question.

Method

Study design and population

These data were obtained from a larger longitudinal observational study, which has been described in detail elsewhere (Schulz *et al.*, 2014). Patients were considered eligible for study participation if (1) they were on a waiting list for kidney-only transplant or were eligible for this waiting list and (2) aged 18 years or older. The waiting list for kidney transplantation consisted of 897 patients in the catchment area of the transplant centre in the northern part of The Netherlands, of whom 40 were excluded because they did not meet the inclusion criteria (i.e., did not understand the Dutch language, visually impaired or illiterate, or having a diagnosis of a psychiatric condition). Additionally, 362 patients declined study participation. Of the 495 who agreed to the study, 319 received a transplant and comprised the final sample. These patients completed one or more of the following four assessments: pre-transplantation (T0), 3 months post-transplantation (T1), 6 months post-transplantation (T2), and 12 months post-transplantation (T3; see Figure 1). Table 1 presents sample characteristics. Table S1 provides more information on the patterns of missingness within the study sample. When comparing transplanted patients who wanted to participate in the study with transplanted patients who did not want to participate in the study, a significant effect of age was found; participants were significantly older compared to non-participants, $M_{\text{non-participants}} (SD) = 50.68 (14.02)$, $M_{\text{participants}} (SD) = 56.00 (12.50)$, $t(364.61) = -4.32$, $p < .01$. No differences between participants and non-participants were found for gender. No significant differences were found between the group of non-transplanted participants and transplanted participants on baseline levels of benefit finding, distress, optimism, comorbidities, and symptoms ($p > .05$).

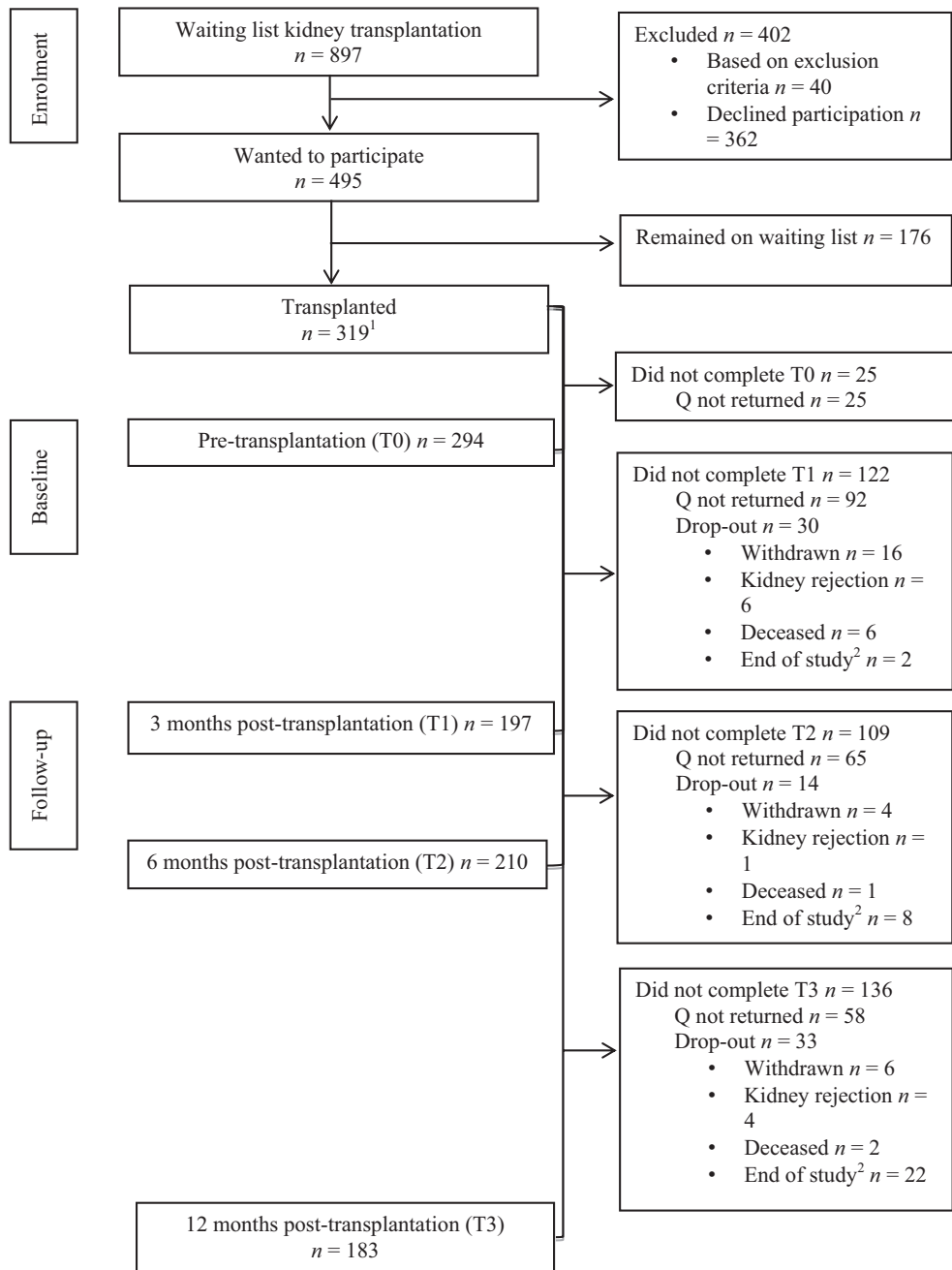


Figure 1. Flow chart of participants in the study. ¹This is the reference number of the flow chart. ²Follow-up questionnaires could not be sent because of end of study.

Procedure

The Medical Ethical Committee of The University Medical Center Groningen approved the study protocol with reference number METc2007/187. Patient recruitment took place

Table 1. Study sample characteristics ($N = 319$)^a

Age; M (SD)	53.1 (12.5)
Male gender; N (%)	181 (56.7)
Education; N (%)	
Elementary	111 (39.1)
Secondary	128 (45.1)
University	45 (15.8)
Partner (yes); N (%)	230 (78.8)
Dialysis (yes); N (%)	229 (75.8)
Dialysis type; N (%)	
Haemodialysis	155 (51.3)
Peritoneal dialysis	74 (24.5)
No dialysis	73 (24.2)
Years on dialysis; M (SD)	3.5 (2.2)
Donor type	
Deceased donor; N (%)	168 (53.5)
Living donor; N (%)	146 (46.5)
Number of transplants; N (%)	
First	285 (89.3)
Second	29 (9.1)
Third	5 (1.6)
Kidney function (24-hr creatinine clearance)	
T1	52.7 (18.9)
T2	54.2 (19.6)
T3	55.5 (19.4)

Note. ^aNumbers may slightly differ between variables due to missings.

between July 2008 and July 2013. Prior to study participation, all participants provided informed consent. Participants completed the pre-transplant assessment every year until they received a transplant. The most recent pre-transplantation assessment was used in the analyses as the T0 variable.

Measures

Demographic characteristics and clinical variables

Gender, age, donor type, dialysis type, time on dialysis, number of transplantations, and kidney function as indicated by 24-hr creatinine clearance were obtained from patients' medical records. Patients self-reported their relationship status and level of education.

Symptoms

A symptoms checklist was adapted by combining and reconciling overlapping items from the widely used and accepted Kidney Disease Quality of Life Questionnaire (KDQoL; Hays, Kallich, Mapes, Coons, & Carter, 1994) and End-Stage Renal Disease-Symptom Checklist-Transplantation Module (ESRD-SCL-TM; Franke *et al.*, 1999). In addition, three items on sleep quality and four items on sexual functioning/interest were added from the SCL-90 (Derogatis, Lipman, & Covi, 1973) and the Psychosocial Adjustment to Illness Scale (PAIS; Derogatis, 1986) respectively, because they were missing from de KDQoL and ESRD-SCL-TM but featured prominently in literature on symptoms of ESRD (Navaneethan *et al.*, 2010;

Yngman-Uhlin & Edéll-Gustafsson, 2006). Two consulting nephrologists approved the questionnaire. This resulted in a 32-item symptoms checklist including items on muscle pain, headaches, exhaustion, nausea, thirst, itching, tiredness, and reduced sexual interest. Patients indicated whether they experienced the symptoms in the last 12 months (yes/no). The present symptoms were summed into a total score for further analyses.

Comorbidity

The number of comorbidities was measured with a checklist of twenty common chronic diseases based on a questionnaire used by the Central Statistical Office in their national surveys in The Netherlands. The same questionnaire has also been used in other research (Arnold *et al.*, 2004; Kempen, Ormel, Brilman, & Relyveld, 1997). It included conditions like asthma, serious heart condition or heart attack, stroke, diabetes mellitus, migraine or chronic headache, cancer, or psychological problems such as anxiety or depression. Patients reported whether they had experienced the condition now or in the last 12 months (yes/no) and whether they received any treatment for it (yes/no). The number of conditions for which patients had received treatment in the last 12 months was added in order to calculate the total number of comorbidities.

Benefit finding

Benefit finding was measured with the disease benefits subscale of the Dutch Illness Cognition Questionnaire (ICQ; Evers *et al.*, 2001). This subscale consists of 6 items, for example, 'Dealing with my illness has made me a stronger person'. Items were rated on a 4-point Likert scale (1 = not at all, 2 = somewhat, 3 = to a large extent, 4 = completely). The ICQ has not been used in people with end-stage renal disease or renal transplant recipients; however, it has shown adequate psychometric properties in other chronic illnesses, such as rheumatoid arthritis and multiple sclerosis (Evers *et al.*, 2001) and across patients with chronic pain and chronic fatigue (Lauwerier *et al.*, 2010). Cronbach's α for our sample was .85 (T0), .87 (T1), .87 (T2), and .86 (T3).

Distress

Psychological distress was measured with the shortened 12-item version of the General Health Questionnaire, rated on a 4-point Likert scale (GHQ-12, Goldberg & Williams, 1988). The GHQ-12 is widely used for assessing psychological distress in different chronic conditions, including renal transplant patients (Prihodova *et al.*, 2010). Half of the items are negatively worded, for example: 'Have you recently felt you couldn't overcome your difficulties?' The items were added with a final sum score ranging from 0 to 36, with a higher score indicating more distress. Cronbach's α in the current sample was .87 (T0), .89 (T1), .90 (T2), and .89 (T3).

Optimism

Dispositional optimism was assessed with the Life Orientation Test (LOT; Scheier & Carver, 1985). Research indicates that the LOT consists of two separate factors, with four positive items loading on one factor (optimism) and four negative items loading on another factor (pessimism; Glaesmer *et al.*, 2012; Herzberg, Glaesmer, & Hoyer, 2006). In this study, optimism was measured with four positively worded items that are rated on a 5-

point Likert scale (1 = strongly disagree to 5 = strongly agree). An example is: 'In uncertain times, I usually expect the best'. The final sum score ranges from 4 to 20, with a higher score indicating higher optimism. Psychometric properties of the complete Life Orientation Test are adequate (Terrill, Friedman, Gottschalk, & Haaga, 2002; Vassar & Bradley, 2010). Cronbach's α of the optimism subscale in the current sample was .71 (T0), .86 (T1), .82 (T2) and .87 (T3).

Statistical analyses

Given the hierarchical two-level structure of the data (i.e., multiple assessments within individuals), data were analysed with a multilevel model using Mplus version 7.4 (Muthén & Muthén, 2012) and maximum likelihood estimation method. Multilevel modelling is used to account for the fact that the repeated assessments were correlated within individuals.

One strength of multilevel modelling is that all of the data are used in the analysis, compared to repeated measures analysis of variance which would retain data only on those who completed all assessments. In addition, multilevel modelling allows the separation of within-person effects (at the 'assessment level') from the between-person effects (at the 'person' level) in the same model. Unlike the usual longitudinal-multilevel modelling, both the time-varying predictors and the outcome variable were decomposed into their within and between components in order to adequately study the relations between predictor and outcome at both levels. Modelling and reporting both within- and between-person effects is required when the effects at the different levels may differ. The within-person effects represent individual changes over specific time-points – for example, the influence of the independent variable at a specific time-point on the dependent variable within that same individual at the same time-point (concurrent) or at the following time-point (lagged). The between-person effects represent the extent to which people who overall (time-invariant) report high levels on the independent variable differ in their levels of the dependent variable compared to people who overall report low levels on the independent variable.

The Bayesian information criterion (BIC) and Akaike's information criterion (AIC) were used to evaluate model fit, with lower values indicating better model fit. The residual variability is considered constant.

To examine whether BF changed from T0 to T3, a random intercept multilevel model was applied. Time (within-person) was included as a categorical (dummy-coded) variable, given that no *a priori* shape of the development in BF was assumed. A random slope for time-varying predictors was not included because it did not improve model fit (as indicated by higher AIC and BIC values, and negligible variance of the random slope).

To examine whether disease-related characteristics and optimism were associated with BF from T0 to T3, we applied concurrent longitudinal models that measure the association between these variables and BF over time (separate models for each variable). Both the within-person and between-person effects were examined. At the within-person level, we entered number of symptoms, number of comorbidities, and optimism as time-varying independent variables, predicting BF at the same time. At the between-person level, the random intercepts of the independent variables and BF were allowed to correlate. Number of comorbidities was treated as a Poisson distribution (not normally distributed), whereas number of symptoms, optimism, and BF were normally distributed.

All analyses were performed for the total group of 319 participants, with the exception of the analysis examining the relation between time on dialysis and BF, in which only

patients who were on dialysis pre-transplantation were included (see Table 1 for information on number of patients on dialysis). Moreover, given that time on dialysis was only measured at T0, only the between-person effects could be examined.

To examine the longitudinal relations between BF and distress from T0 to T3, a multilevel autoregressive cross-lagged time model was applied across the four time-points (see Appendix S1 for the Mplus code of the model). At the within-person level, it was examined whether both benefit finding and distress at each time (t) could be predicted by their own lagged value ($t-1$) and the lagged value of the other variable ($t-1$). At the between-person level, random intercepts of BF and distress were allowed to correlate.

Results

Changes in benefit finding T0–T3

As shown in Table 2, BF significantly increased from pre-transplantation (T0) to post-transplantation (T1) and remained stable thereafter (T2 and T3). Table 3 also shows that BF post-transplantation (T1, T2, and T3) significantly increased compared to BF at baseline (T0). Even given a slight increase from pre-transplantation to post-transplantation in the non-transplanted group, increases were larger in the transplanted group (see Table S2 for additional information on the multilevel model of the non-transplanted group).

The association of disease-related characteristics and optimism to benefit finding T0–T3

Symptoms

As shown in Table 4, both within- and between-person effects were found for the association between number of symptoms and BF. Increases in symptoms within an individual were associated with decreases in BF. Specifically, a one-unit increase in symptoms was associated with a .07 decrease in BF at the same time (see Table 4). The between-person effects indicated that scoring above average in symptoms was related to scoring below average in BF over all time-points.

Table 2. Averages of variables and effect sizes of change between time-points

	Mean (SD)				Effect size (d)		
	T0 (N = 292) ^a	T1 (N = 196) ^a	T2 (N = 207) ^a	T3 (N = 183) ^a	T0–T1	T1–T2	T2–T3
Benefit finding	14.99 (4.52)	16.63 (4.42)	16.83 (4.45)	16.93 (4.22)	.37**	.05	.02
Distress	11.13 (5.08)	8.85 (5.72)	9.21 (5.80)	9.31 (5.14)	.42**	.06	.02
#Symptoms	12.95 (6.68)	11.43 (6.41)	11.52 (6.40)	11.20 (6.53)	.23**	.01	.05
#Comorbidities	1.64 (1.38)	1.48 (1.22)	1.44 (1.35)	1.31 (1.30)	.12	.03	.10
Optimism	14.86 (2.45)	14.99 (3.13)	15.15 (2.76)	15.01 (3.23)	.05	.05	.05

Notes. Means and effect sizes were calculated based on the sample of participants completing one or more of the assessments (T0, T1, T2, and/or T3). p -Values were calculated with paired samples t -tests. For number of comorbidities, the p -values were calculated with the non-parametric Wilcoxon signed rank test because number of comorbidities was not normally distributed.

^aNumbers may slightly differ between variables due to missings.

** $p \leq .01$.

Table 3. Multilevel model of changes in benefit finding over time with fixed and random effects

	Estimate (SE)	<i>p</i>
Fixed effects		
Intercept	15.01 (0.26)	<.01
T0	(reference)	
T1	1.67 (0.27)	<.01
T2	1.95 (0.25)	<.01
T3	2.00 (0.26)	<.01
Random effects		
Intercept	12.58 (0.97)	<.01

Number of comorbidities

As shown in Table 4, no within-person effects were found for number of comorbidities and BF. A between-person effect was found, indicating that those who scored above average in number of comorbidities scored below average in BF over all time-points.

Time on dialysis

No between-person effect was found for time on dialysis on BF.

Optimism

Both within-person and between-person effects were found for the relation between optimism and BF (see Table 4). The within-person effect showed that a one-unit increase in optimism was associated with a .16 increase in BF at the same time. The significant between-person effect showed that those who scored above average in optimism also scored above average in BF over all time-points.

Longitudinal relation between benefit finding and distress T0-T3

As shown in Figure 2, distress predicted BF over time, but the direction of that relation changed. The within-person effect showed that distress pre-transplantation (T0) significantly predicted an increase in BF at T1, but an increase of distress at T1

Table 4. Concurrent multilevel models predicting benefit finding

	Within-person		Between-person	
	Estimate (SE)	<i>p</i>	<i>r</i> ^a	<i>p</i>
# Symptoms	-.07 (.03)	.01	-.15	.02
# Comorbidities	-.10 (.10)	.35	-.28	<.01
Optimism	.16 (.06)	<.01	.47	<.01
Time on dialysis			Estimate (SE)	<i>p</i>
			.03 (.11)	.81

Notes. Variables were introduced in separate models.

^a*r* = random intercept correlation.

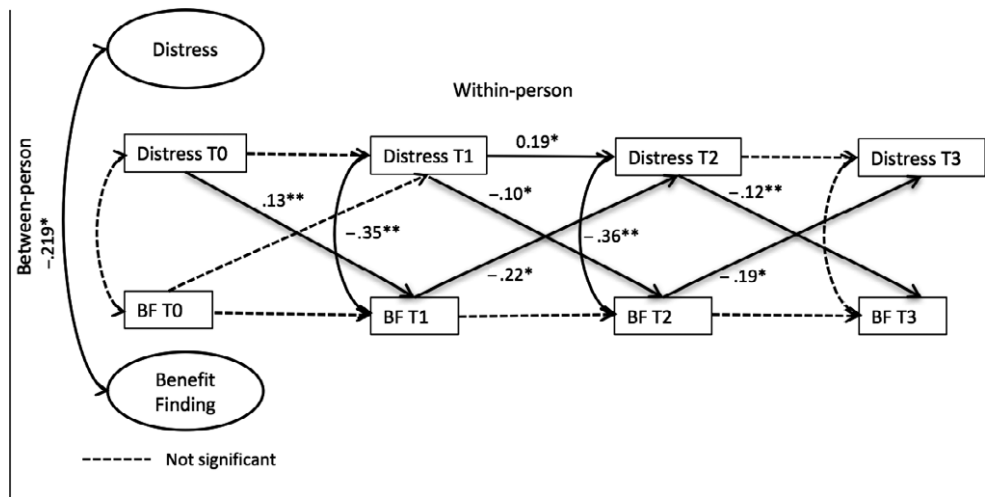


Figure 2. Cross-lagged autoregressive model of distress and benefit finding pre- to post-transplantation. $*p \leq .05$; $**p \leq .01$. Note. Coefficients of non-significant paths are not shown. Round double-arrows represent correlations. Straight one-way arrows represent regression coefficients.

significantly predicted a decrease in BF at T2 and an increase of distress at T2 predicted a decrease in BF at T3. Figure 2 also shows that BF pre-transplantation (T0) was not associated with distress post-transplantation (T1); however, post-transplantation each lag showed that an increase in BF was associated with a subsequent decrease in distress. There was also a significant between-person effect showing that a score above average in BF was associated with a score below average in distress across all time-points (see Figure 2).

Discussion

This is the first prospective study examining benefit finding (BF) before and after a positive medical intervention, that is, kidney transplantation in individuals with end-stage renal disease. BF increased from pre- to 12 months post-transplantation. A decrease in symptoms and an increase in optimism were concurrently related to an increase in BF. Overall, individuals with fewer symptoms and comorbidities, and more optimism, had a higher level of BF across all time-points. We found no relation between time on dialysis and BF. Longitudinal analyses revealed that distress pre-transplantation predicted an increase in BF 3 months post-transplantation, but then an increase in distress post-transplantation predicted a decrease in BF on a subsequent time-point. Furthermore, BF pre-transplantation was not related to distress post-transplantation, whereas an increase in BF post-transplantation predicted a later decrease in distress. This finding is also congruent with the fact that overall, individuals with a higher level of BF had a lower level of distress across all time-points. Importantly, the findings show that fewer mental and physical problems are overall related to more BF, whereas more mental health problems pre-transplantation were related to more BF post-transplantation. This shows that the association between two variables can change due to the transplantation.

This study provides support that a positive medical intervention, such as transplantation, can facilitate the identification of benefits related to one's illness (Fox *et al.*, 2014).

This finding expands on previous research, as BF has primarily been studied in the context of adverse events such as the diagnosis of an illness (Danoff-Burg & Revenson, 2005; Harrington, McGurk, & Llewellyn, 2008; Milam, 2004; Rogan, Fortune, & Prentice, 2013), and has not been measured before and after a positive medical event. Thus, BF may not only arise as a response to a health *threat*, but also as a response to a health *improvement*.

The current findings suggest that experiencing fewer symptoms and fewer related health problems can support the identification of benefits following illness. This is in contrast to the theory that suggests, more severe health threats would inspire more BF (Tedeschi & Calhoun, 1996). Importantly, in this study disease severity was assessed with subjective measures of severity (i.e., self-reported symptoms and comorbidities) as opposed to objective measures. According to previous research in life-threatening illnesses, BF might be related differently to measures of objective and subjective disease severity, with subjective measures showing more consistent associations with BF than objective measures (Harrington *et al.*, 2008; Koutrouli *et al.*, 2012). Further studies on different indicators of disease severity in the context of a positive medical intervention should clarify whether experiencing fewer health problems is consistently related to more BF.

Consistent with previous research, optimism was related higher to BF (Dunn *et al.*, 2011; Helgeson *et al.*, 2006; Pascoe & Edvardsson, 2013; Prati & Pietrantonio, 2009). However, the majority of previous research is cross-sectional. The longitudinal nature of this study adds empirical evidence to the notion that an optimistic character contributes to experiencing benefits over time (Affleck & Tennen, 1996).

From theory, it has been proposed that growth emerges when more time passes since the onset of a traumatic event given that individuals have more time to process the event (Tedeschi & Calhoun, 1995). It is difficult to extrapolate this theory to the current study, because it is not clear whether a longer time on dialysis pre-transplantation is related to an extension of a distressing situation, or whether individuals who dialyse for a longer period have processed, and thus learned to accept and deal with their disease. Moreover, findings on the relation between time since diagnosis and BF seem to be inconsistent (Helgeson *et al.*, 2006). Future longitudinal research should further examine the trajectory of BF from the start of dialysis through post-transplantation. Addressing this topic might give more insight in the extent to which the duration on dialysis influences the way people view and cope with their condition.

Lastly, an attempt was made to disentangle the temporal relation between BF and distress in the course of 12 months post-transplantation. Although it is not clear why the association between distress and BF changed over time, the finding that more distress pre-transplantation is related to more BF post-transplantation might indicate that higher levels of distress before a positive medical intervention could activate BF in order to reduce distress over the course of the intervention. The finding that lower levels of distress after the transplant are related to a subsequent increase in BF might indicate that an improvement in well-being promotes the recognition of positive life changes that have occurred due to the transplant. Moreover, the relation between distress and BF after transplantation seems to be reciprocal, such that an increase in BF after the transplant is also related to a subsequent decrease in distress. Interestingly, the findings suggest that the relation between distress and BF can change from pre- to post-transplantation and therefore stresses the importance of research longitudinally examining the association between BF and well-being.

Previous research on the direction of the relation between BF and distress has been inconsistent (Barskova & Oesterreich, 2009; Helgeson *et al.*, 2006; Koutrouli *et al.*, 2012;

Pascoe & Edvardsson, 2013). A possible explanation for the lack of conclusive evidence may be the diversity of study designs (longitudinal vs. cross-sectional). Most studies on BF are cross-sectional and report null-findings or a positive relation between BF and measures of psychological health. However, longitudinal studies overall consistently show that BF predicts better mental and physical health (Chen, Zhou, Zeng, & Wu, 2015; Danoff-Burg & Revenson, 2005; Hart, Vella, & Mohr, 2008; Husson *et al.*, 2017; Schwarzer, Luszczynska, Boehmer, Taubert, & Knoll, 2006; Wang *et al.*, 2017). Accordingly, this prospective study showed consistent links between more BF and lower levels of distress in the context of a positive medical intervention.

Before concluding, we acknowledge a number of study limitations. First, although the longitudinal nature of this study provides the opportunity to disentangle causal relations, it remains difficult to establish causality between distress and benefit finding pre- to post-transplantation. Other explanations might be possible. For example, distress may act as a moderator or mediator in the effect of transplantation on (changes in) benefit finding. This might be explored further in future research. More assessment points and shorter time in between assessments could provide a more detailed picture of the relation between BF and distress before and after a positive medical intervention. The first assessment post-transplantation was 3 months post-transplantation. Therefore, it is unclear *how* BF and distress relate directly post-transplantation, when feelings of distress might predominate because patients still need to adapt to a life-changing situation. Second, BF was measured with a questionnaire not differentiating between distinct domains in which patients can experience benefits, such as changes in interpersonal relationships, personal changes, or spiritual changes (Tedeschi & Calhoun, 1996). This could be important information, because it might give more insight into the particular domains on which patients can experience BF and how these relate to distress. Lastly, future studies might identify specific patient characteristics related to improvements in BF from pre- to post-transplantation, such as adaptive or non-adaptive perceptions of one's illness.

Our study indicates that not only a negative event, but also a positive medical intervention can facilitate the development of benefit finding. Moreover, after transplantation, an increase in BF predicted a decrease in distress and this relation appeared to be reciprocal. Although the idea of developing a stress-reduction intervention aimed at enhancing benefit finding is tempting, we should be cautious before promoting such interventions. As this is the first study to examine benefit finding before and after transplantation, more research is warranted to gain a deeper understanding of the mechanisms that underlie these changes in benefit finding and to what extent improved benefit finding contributes to improved quality of life and well-being in the long term. Research might also extend this line of investigation to other positive (medical) events to see whether similar findings emerge. A broader understanding of the relation between benefit finding and psychological and physical health could inform future psychological interventions.

Acknowledgements

This work was supported by grant SWO2013.03 from the Dutch Kidney Foundation.

Conflict of interest

All authors declare no conflict of interest.

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Received 12 February 2018; revised version received 17 October 2018

Supporting Information

Additional Supporting Information may be found online in the Supporting Information section at the end of the article.

Table S1. Information on patterns of missingness within the study sample.

Table S2. Multilevel model of changes in benefit finding over time for the non-transplanted group with fixed and random effects.

Appendix S1. Mplus code for the autoregressive model of Distress and Benefit Finding pre- to post-Transplantation.