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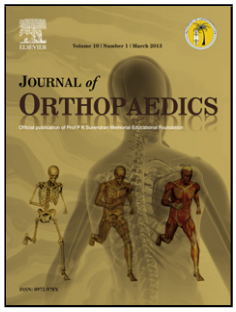

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PII: S0972-978X(17)30326-4
DOI: https://doi.org/10.1016/j.jor.2018.01.004
Reference: JOR 423

To appear in:

Received date: 12-9-2017
Accepted date: 12-1-2018

Please cite this article as: Michael Nganga, Donald Bramwell, Jenifer Monaghan, Christine Doerr, Graham Mercer, Jeganath Krishnan, Evaluation of the Multi-Attribute Prioritisation Tool for Total Joint Replacement (2010), https://doi.org/10.1016/j.jor.2018.01.004

Evaluation of the Multi-Attribute Prioritisation Tool for Total Joint Replacement

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Abstract

Rationale, aims and objectives: The demand for arthroplasty is increasing and will continue to rise with an ageing population. Obesity and lengthy waiting time for Total Joint Replacement (TJR) have been associated with poorer outcomes postoperatively. This study aimed to evaluate the Multi-Attribute Prioritisation Tool (MAPT) for TJR patients. The primary objective was to explore if patients prioritised by the MAPT had an improvement in score post-operative. Further to identify any relationship between MAPT score and length of time on the waiting list or obesity.

Method: This retrospective cohort study included 308 patients undergoing total hip (n = 114) or total knee (n = 194) arthroplasty. We examined preoperative and postoperative MAPT scores of patients who had total hip or total knee arthroplasty. After assessing the difference between postoperative and preoperative MAPT scores, patients scores were compared to BMI and

waiting time classes. BMI was allocated to less than 30, 30-35, 35-40 and greater than 40. Duration of time on the waiting list was allocated to less than 6 months and greater than 6 months.

Results: THA and TKA patients MAPT scores improved from a preoperative score of 71.39 to 5.26 postoperative and 54.11 to 7.13 respectively. Patients whose MAPT scores placed them in the high priority category had a significant relationship with length of time on the waiting list ($p<0.01$). There were no significant differences between length of time on the waiting list and improvement scores for low priority and middle priority patients. BMI had minimal effect on patients improvement score postoperative.

Conclusion: TJR patients prioritised by the MAPT questionnaire do experience pain relief as portrayed by a reduction in postoperative MAPT score. A longer length of time on the waiting list seems to effect the improvement a high priority patient can have postoperative.

Keywords: Multi-attribute prioritisation tool; Total Hip Replacement; Total Knee Replacement

Introduction

End-stage osteoarthritis is a leading cause of joint degeneration of the hip or knee joint commonly treated by Total Hip Replacement (THR) or Total Knee Replacement (TKR).[1] Total Joint Replacement surgery (TJR) procedures are predicted to increase in the coming years.[2] The Australian Association National Joint Replacement Registry (AOANJRR) in their 2014 Annual Report confirmed that the number of hip and knee procedures has increased by 46.5% and 77.2%, respectively since 2003.[3] Lack of structure in an approach to prioritising patients' surgery has been known to lead to lengthy waiting times.[4,5] Increased waiting times create a barrier to the provision of optimal and timely management of joint replacement which can lead to physical deterioration of the hip or knee.[4,6] Length of time spent on the waiting list

has raised concerns around access to patient care and surgical outcome.[5,7] The development of a systematic waiting list to aid in the prioritisation of patients who required TJR was needed.

The Multi-Attribute Prioritisation Tool (MAPT) was designed for classification of patients requiring TJR into severity categories, and to aid in the construction of a systematic waiting list based on urgency.[6] Quality-of-life questionnaires such as the SF-12 and SF-36 are generic health status measures used to measure the impact of patient knee or hip dysfunction on their quality of life.[8] Questionnaires specific to diseases such as osteoarthritis include the Western Ontario and McMaster osteoarthritis index (WOMAC) and the Oxford Hip/Knee scores assess pain and physical function of the patients' hip or knee.[8,9] The MAPT, specifically designed for prioritisation, has shown high correlations with the WOMAC (r=0.78) and the Oxford Hip/Knee score (r=0.86/0.75), demonstrating a good assessment of patient pain and physical function.[10]

The MAPT has been in use at our institution since 2008.[6] Patients referred are issued the MAPT which aims to assess pain, limitations to daily activities, psychological health impact, economic impact, recent deterioration and conservative treatment.[2] MAPT questionnaires are used initially when patients first present to an outpatient clinic and periodically whilst on the waiting list. The MAPT consists of eleven question domains which were constructed to capture issues relevant to patients and to surgeons determining priority for surgery.[2,7] The questions are Guttman items which involve a descriptive stem followed by several defined health states of increasing severity.[2] They are similar to those the surgeon would ask to assess the patients' disease burden.[2] A MAPT score aims to provide a subjective assessment of patients' symptoms.[7] This gives an indication of how severe the patient perceives the pain. An example of a Guttman question is provided in Figure 1.

Figure 1: Example of Guttman question in MAPT questionnaire

Priority is indicated in the MAPT score through values from 0 – 100; a score of 0-20 indicates low priority, indicating surgery may in fact be needed and conservative options more vigorously pursued. A score of 21-60 indicates middle priority and that surgery is needed soon. A score of 61-100 indicates high priority and surgery is required urgently.[7]

For the past 8 years MAPT has been used at our institution as a part of prioritisation in TKR and THR. A previous internal study at our institution, compared MAPT scores before and after surgery and identified the level of improvement patients experienced as a result of the surgery.[6] Researchers found that the majority of patients had improvement after TJR, however pain still persisted for some. Contributing factors to postoperative pain were limited to patients' personal situation and were not identified further. Additional research on the MAPT questionnaire has been centred on its development, implementation, and management of the waiting list.[2,6] There is limited evidence investigating the relationship between MAPT scores and factors which could influence postoperative improvement. One study looked at the relationship between MAPT scores and disease severity in terms of surgical waiting list and radiological assessment.[7] They concluded there were no significant relationships between the MAPT score and radiographic severity of osteoarthritis. Furthermore, there was no relationship between MAPT score and surgical waitlist category of patients waiting for THR or TKR. There have been no other studies looking at the relationship between MAPT score and length of time on the waiting list.

The literature on obesity with regards to TJR shows that there are significant adverse effects on the outcome of surgery for those with a high body mass index (BMI) in comparison to lower BMI patients. Furthermore, an increase in frequent complications and greater occurrence of infection are associated with a high BMI.[11,12] Obese patients have been defined to have a BMI>30kg/m^2 and morbidly obese with a BMI>40kg/m^2.[12] Additionally, obese and

morbidly obese patients have a higher risk of revision after surgery and lower functional outcome scores.[11]

The purpose of this study is to evaluate the Multi-Attribute Prioritisation Tool (MAPT) as a prioritisation tool for TJR patients and identify if TJR patients experience improvement by comparing the difference of postoperative and preoperative MAPT scores. Furthermore, identify if length of time on the waiting list or BMI have an impact on postoperative MAPT scores. Particular focus was placed on identifying whether prolonged time on the waiting list resulted in poorer improvement for high priority patients after TJR. Authors sought to identify if obese patients had poorer improvement scores following TJR compared to non-obese patients.

Method

This is a retrospective review which investigated data sets of MAPT questionnaires and scores preoperative and postoperative. The inclusion criteria were any patients who underwent THA or TKA from June 2008 – March 2009 and completed MAPT questionnaires. Clinicians had recorded gender, age, MAPT score preoperative and 6 months postoperative, BMI, date of operation, date patient was added to waiting list and the surgery being received. Retrospectively, researchers collated and analysed questionnaires of these patients. Preoperative and postoperative MAPT scores were compared to identify an improvement score. Additional analysis was conducted to compare MAPT improvement scores to patient BMI and length of time on the waiting list.

Table 1: Patient Demographics

Data Extraction

A total of 308 THA (114 hips) and TKA (194 knees) patients completed the MAPT questionnaires between the required time periods. Preoperative MAPT scores were categorised

into low priority (0-20), middle priority (21-60) and high priority (61-100). Improvement scores were found by calculating the difference between preoperative and postoperative scores.

Waiting periods of patients were compared against improvement MAPT scores to identify any correlation between length of time on the waiting list and improvement of MAPT score. Obesity has previously been defined as BMI>30kgm^2.[12] For the purposes of this study, patients were grouped by BMI into four categories for comparison and to encompass for those with a BMI <30kgm^2. BMI classes included non-obese class 1(BMI<30 kg/m^2), obese class 2 (BMI between 30kg/m^2 and 35kg/m^2), obese class 3 (BMI between 35kg/m^2 and 40kg/m^2) and obese class 4 (BMI>40 kg/m^2). The mean values of the preoperative and postoperative MAPT scores were found and compared for each obesity class. Obesity classes were also compared to improvement MAPT scores to see if there was any relationship between BMI and improvement of MAPT scores.

Statistical Analyses

Statistical significance was identified using IBM SPSS Statistics 22. Variables were described using mean, mode and range values. Comparisons between means were made using one-sampled t-tests. Correlation between length of time on waiting list and BMI with improvement MAPT score was found using two-tailed Pearson correlation. A p value <0.05 was considered statistically significant for all tests.

Results

A significant difference was found comparing preoperative and postoperative MAPT scores ($p<0.001$). The overall mean score preoperative for THA and TKA patients were 60.50 and mean postoperative score was 6.45. Postoperative mean scores for THA and TKA were 5.26 and 7.13, respectively (Table 1).

Table 2: Mean, median and range of MAPT scores preoperative, 6 months postoperative and variations for hip and knee

The mode for both THR and TKR patients was 0.03 postoperatively. Analysing the difference between preoperative and postoperative MAPT scores, hip and knee improvement score were found to be significant ($p<0.01$). A mean improvement score for patients who had THA was 66.31 and scores ranged from an improvement of 99.9 to a gain in score of 7.1. Of the 114 THA patients, however, only three patients had a gain in score. Two patients had improvement on the operated hip, but required THA on the other hip 6 months postoperative. One patient with a low MAPT score had a gain in score, but remained in the low priority category. The mean improvement score for patients who had TKA was 47.00 and scores ranged from an improvement of 99.5 to a gain of 55.27. There were ten patients of the 194 who resulted with a gain in score 6 months after TKA. These patients either required surgery for the previously non-operated knee or hip, had an accident which impacted the operated on knee postoperative while still recovering, or their condition stayed the same or worsened. For the patients whose conditions had no change or worsened, majority of them reported excellent care.

The priority categories of the patients were also identified. Low priority (0-20) had 54 patients, middle priority (21-60) had 86 patients and high priority (61-100) had 168 patients. It was found irrespective of priority category, patients had significant improvement. Postoperative scores of the high priority and low priority patients were compared. The mean postoperative scores for low and high priority patients proved to be similar, 4.86 and 7.70 respectively (Table 2). Low and middle priority postoperative scores were also found to be similar. The mode for each priority category was 0.03 indicating most patients from each category had postoperative improvement in MAPT score.

Table 3: Mean postoperative MAPT scores, standard deviations and range for low priority, middle priority and high priority patients

Preoperative MAPT scores were compared to 6 month time intervals to identify a relationship between prioritisation and waiting times.

Figure 2: Comparison of the length of time on the waiting list (6 month intervals) and preoperative mean MAPT scores

As displayed in Figure 2, there is strong correlation between length of waiting time and preoperative MAPT score averages ($p<0.01$). Majority of high priority patients were seen first, followed by middle and low priority patients. When comparing length of waiting time and mean improvement score for all patients at the 6 month time point, a highly significant ($p<0.01$) positive correlation is also demonstrated (Figure 3).

Figure 3: Comparison of length of waiting time on the waiting list (6 month period) and improvement mean MAPT score

The graph above shows patients who waited over a year for surgery still displayed improvement. In order to further identify the length of time on the waiting list and any correlation with improvement score for patients, improvement scores of each category were compared against waiting time (Figure 4).

Figure 4: Comparison of category 6, 12, 18 and 24+ months on the waiting list and improvement mean MAPT scores of high, middle and low priority patients

Middle priority patients and patient improvement scores were found not to be significantly different ($p=0.45$). The same was found for low priority patients ($p=0.45$). Comparison of high priority patient's improvement score and length of time on the waiting list found a significant relationship ($p<0.01$).

Regarding obesity, non-obese class 1 had 115 patients, obese class 2 had 74 patients, obese class 3 had 42 patients and obese class 4 had 24 patients. Postoperative MAPT scores 6 months after surgery regardless of BMI classes had all improved. The majority of patients reached a score of zero or close to zero. One patient with a BMI of 85kg/m^2 and a preoperative score of 58.78 experienced similar improvement after surgery, with their postoperative score resulting in an 8.98.

Figure 5: Preoperative and Postoperative MAPT score averages for non-obese class 1, obese class 2, obese class 3 and obese class 4

Irrespective of which obese class the patient was in, all classes appeared to have a similar level of improvement. There was no significant difference between obese classes and improvement MAPT score. Some patients from each obesity class had little to minimal improvement, indicated by the range in scores postoperatively.

Table 4: Mean postoperative MAPT scores and range for obese classes

Discussion

The present study was a retrospective review on patients who had TKR or THR and completed patient-reported MAPT questionnaires preoperatively and postoperatively between June 2008 – March 2009. Previous literature has found the MAPT to be well validated and show a high level of agreement between other quality of life questionnaires.[2] The MAPT questionnaire demonstrates a good assessment of patient pain and physical function.[10]

The impact THA and TKA have on the quality of life in patients with osteoarthritis has previously been found to result in substantial postoperative improvement. THA patients after surgery have earlier improvement in pain and stiffness, and greater general health and satisfaction scores.[13,14] TKA patients have shown to have greater functional improvement after surgery.[14] Within the literature, studies have found THA patients have slightly greater

improvement compared to TKA patients. One study confirms that both procedures result in postoperative improvement, however THA was found to have greater benefits than TKA.[13] Results from our study identified THA improvement MAPT scores were greater than TKA, with the statistically significant average change in score of 66.31 and 47.00 respectively. These results suggest that THA patients had greater improvement scores after surgery than TKA patients.

The majority of middle and low priority patients who waited for TJR over a year had similar improvement scores to patients in the same priority category who were operated on sooner. Length of time spent on the waiting list did not impact improvement scores for middle and low priority patients. In the short term of six months post-operative, it seems the length of time on the waiting did not have adverse effects on improvement after TJR. If conditions of the hip or knee begin to worsen however, whilst on the waiting list, it may be appropriate to see patients sooner. The study findings indicate that there is a strong relationship between high priority patient improvement after surgery and the waiting time of patients. High priority patients who wait for an extended period of time for surgery appear to have less postoperative improvement than those on the waiting list for a shorter period. In order for high priority patients to result in improved MAPT scores, a quicker rate of clinical review is needed to reduce waiting times.

BMI had minimal impact on the improvement of the MAPT score. For this subgroup of patients prioritized by MAPT, BMI did not impact on their postoperative MAPT scores in the six month follow-up, however earlier research around obesity and TKA has found that obese patients have a higher revision rate than those with a BMI<30kg/m^2.[11] Our study did not identify revision rates after TJR in the long term.

Given the retrospective nature of this study certain limitations were imposed. BMI scores were provided only for July 2008 – March 2009, hence the month of June was not reported for the analysis. Complete data sets were not available for waiting times and BMI variables. A total of 260 of the 308 patients had reported BMI while 204 of total of 308 patients had recorded waiting times.

Conclusion

Authors aimed to evaluate the MAPT as a prioritisation tool for TJR patients and identify if there were any relationships between MAPT improvement scores and length of time on the waiting list and obesity. It was found patients who were prioritised by the MAPT questionnaire resulted in an improved MAPT score of zero or close to zero postoperatively. There appears to be a relationship between waiting times and high priority patients, but low and middle priority patients had no significant relationship with regards to length of time on the waiting list. BMI had no impact on the MAPT score 6 months postoperatively. Regardless of patient BMI, majority of patients experienced similar improvement in MAPT score. It was not within the scope of this study to assess whether BMI impacted on TKR or THR recovery in the long term, which may be a useful future study. Further follow-up investigations may also include investigating other factors which could impact postoperative improvement for low and middle priority patients. Furthermore, comparing the MAPT to another questionnaire in order to identify how MAPT operates as an effective outcome measure. The MAPT questionnaire has high correlations preoperatively with WOMAC and Oxford Hip/Knee score, but no assessment has been made with an alternative outcome measure.

Acknowledgements

The authors would like to acknowledge the contributions of Daniel Mangos for his assistance with statistical analysis in this study.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1.) Dempsey, K.E., Collins, J.E., Ghazinouri, R., Alcantara, L., Thornhill, T.S. and Katz, J.N. Associations between preoperative functional status and functional outcomes of total joint replacement in the Dominican Republic. *Rheum*. 2013; 52: 1802-1808

2.) Osborne, R., Haynes, K., Jones, C., Chubb, P., Robbins, D. and Graves, S. Orthopaedic Waiting List Project. Victorian Government Department of Human Services 2006

3.) Australian Orthopaedic Association National Joint Replacement Registry Annual Report 2014 [PDF on internet]. Canberra: Commonwealth of Australia, [updated December 2012; cited 3 March 2015] Available from: https://aoanjrr.dmac.adelaide.edu.au/documents/10180/172286/Annual%20Report%202014

4.) Osborne, R., Brand, C., Landgren, F. and Hawkins, M. The Orthopaedic Waiting List Project Phase I: Summary Report. Victorian Government Department of Human Services 2006

5.) Curtis, A.J, Russell, C.O.H, Stoelwinder, J.U and McNiel, J.J. Waiting lists and elective surgery: ordering the queue. *MJA.* 2010; 192(4): 217-220

6.) Doerr, C.R., Graves, S.E., Mercer, G.E. and Osborne, R.H. Implementation of a quality care management system for patients with arthritis of the hip and Knee. *Aus Heal Rev.* 2012

7.) David, V.M., Bousounis, G., Kapakoulakis, T., Champion, R., Masman, K. and McCullough, K. Correlation of MAPT scores with clinical and radiographic assessment of patients waiting THR/TKR. *ANZ J Surg*. 2011; 81: 543-546

8.) Ostendorf, M., Van Stel, H.F., Buskens, E., Schrijvers, A.J.P., Marting, L.N., Verbout, A.J. and Dhert, W.J.A. Patient-reported outcome in total hip replacement – A comparison of five instruments of health status. *JBJS.* 2004; 86: 801-808

9.) Dowsey, M.M. and Choong, P.F.M. The utility of outcome measures in total knee replacement surgery. *Rheum.* 2013

10.) Osborne, R., Bucknill, A., De Steiger, R., Brand, C. and Graves, S. Validation of the multi-attribute prioritisation tool (MAPT) for hip and knee osteoarthritis against WOMAC, Oxford Hip/Knee Score. *JBJS*. 2012; 94(23): 37

11.) Kerkhoffs, G., Servein, E., Dunn, W., Dahm, D., Bramer, J. and Haverkamp, D. The Influence of Obesity on the Complication Rate and Outcome of Total Knee Arthroplasty – A meta-analysis and systematic literature review. *JBJS*. 2012; 94:1839-1844

12.) Merchan, E.C.R. The Influence of Obesity on the Outcome of TKR: Can the Impact of Obesity be justified from the Viewpoint of the Overall Health Care System? *Hos Spec Surg*. 2014; 10(2): 167-170

13.) Hamilton, D., Henderson, G.R., Gaston, P. Macdonald, D., Howie, C. and Simpson, A.H. Comparative outcomes of total hip and knee arthroplasty: a prospective cohort study. *Postgrad Med J*. 2012; 88: 627 - 631

14.) Dailiana, Z.H., Papakostidou, I., Varitimidis, S., Liaropoulos, L., Zintzaras, E., Karachalios, T., Michelinakis, E. and Malizos, K.N. Patient-reported quality of life after primary major joint arthroplasty: a prospective comparison of hip and knee arthroplasty. *BMC Musculoskelet Disord*. 2015; 16: 366

Figure Legends

Figure 1: Example of Guttman question in MAPT questionnaire

Figure 2: Comparison of the length of time on the waiting list (6 month intervals) and preoperative mean MAPT scores

Figure 3: Comparison of length of waiting time on the waiting list (6 month period) and improvement mean MAPT score

Figure 4: Comparison of category 6, 12, 18 and 24+ months on the waiting list and improvement mean MAPT scores of high, middle and low priority patients

Figure 5: Preoperative and Postoperative MAPT score averages for non-obese class 1, obese class 2, obese class 3 and obese class 4

Tables

Table 1: Patient Demographics

	Sex			
	Male (No.)	**Female** (No.)	**Age** (years) (Mean±SD)	**BMI** (Mean±SD)
Total Hip Replacement n=114	43	71	68.32±10.56	30.10±6.29
Total Knee Replacement n=194	79	115	70.40±9.42	32.83±7.20

BMI = Body mass index

Table 2: Mean, median and range of MAPT scores preoperative, 6 months postoperative and variations for hip and knee

		MAPT Score		
Joint	**Measure**	**Preoperative**	**Postoperative (6 months)**	***Difference between preoperative and postoperative scores**
Hip n=114	Mean	71.39	5.26	66.31
	Mode	99.54	0.03	
	Range	2.5-99.98	0.03-92.25	-99.9 – 7.1
Knee n=194	Mean	54.11	7.13	47.00
	Mode	2.51	0.03	
	Range	0.0003-99.99	0.03-99.19	-99.5 – 55.27

**Difference was found by subtracting the preoperative MAPT score from the postoperative MAPT score. A negative value indicates a reduction in score, whereas a positive value indicates a gain in score.*

Table 3: Mean postoperative MAPT scores, standard deviations and range for low priority, middle priority and high priority patients

	MAPT Score

	Measure	Preoperative	Postoperative (6 months)	*Difference between preoperative and postoperative scores
Low n=54	Mean	10.64	4.86	-5.79
	Mode	15.64	0.03	
	Range	0.0003 – 19.29	0.03 – 49.31	-19.26 – 38.33
Middle n=86	Mean	39.33	5.00	-34.52
	Mode	49.32	0.03	
	Range	20.16 – 59.66	0.03 – 87.39	-59.63 – 55.27
High n=168	Mean	87.37	7.70	-79.59
	Mode	97.73	0.03	
	Range	60.02 – 99.99	0.03 – 99.22	-99.9 – 9.42

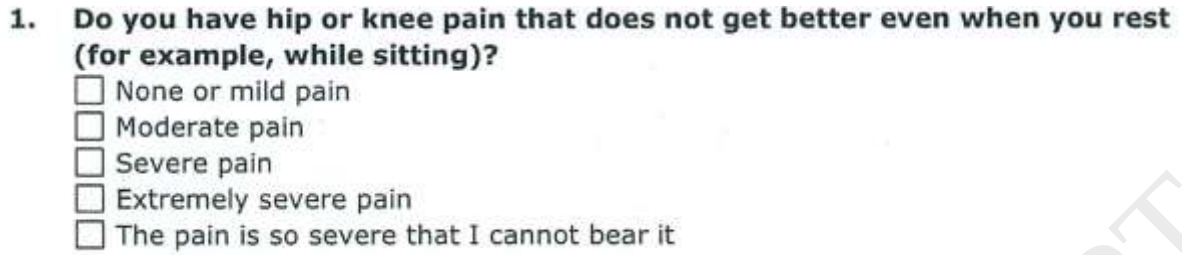
**Difference was found by subtracting the preoperative MAPT score from the postoperative MAPT score. A negative value indicates a reduction in score, whereas a positive value indicates a gain in score.*

Table 4: Mean postoperative MAPT scores and range for obese classes

	Statistic	Preoperative MAPT Score	Postoperative (6 months) MAPT Score	Improvement between preoperative and postoperative scores
Non-obese	Mean	61.57	6.08	-55.83
Class 1	Range	2.51 – 99.97	0.03 – 92.25	-99.71 – 27.13
(BMI<30 kg/m^2)				
Obese Class 2	Mean	61.84	6.12	-55.19
(BMI: 30 kg/m^2	Range	2.51 – 99.98	0.03 – 99.22	-99.45 – 55.27
– 35 kg/m^2)				
Obese Class 3	Mean	63.98	5.94	-58.03
(BMI: 35 kg/m^2	Range	2.51 – 99.73	0.03 – 64.40	-99.50 – -2.48
– 40 kg/m^2)				
Obese Class 4	Mean	56.68	7.28	-49.39
(BMI>40 kg/m$^{2)}$	Range	2.51 – 99.54	0.03 – 49.31	-99.51 – 33.67

Figures

Figure 1:



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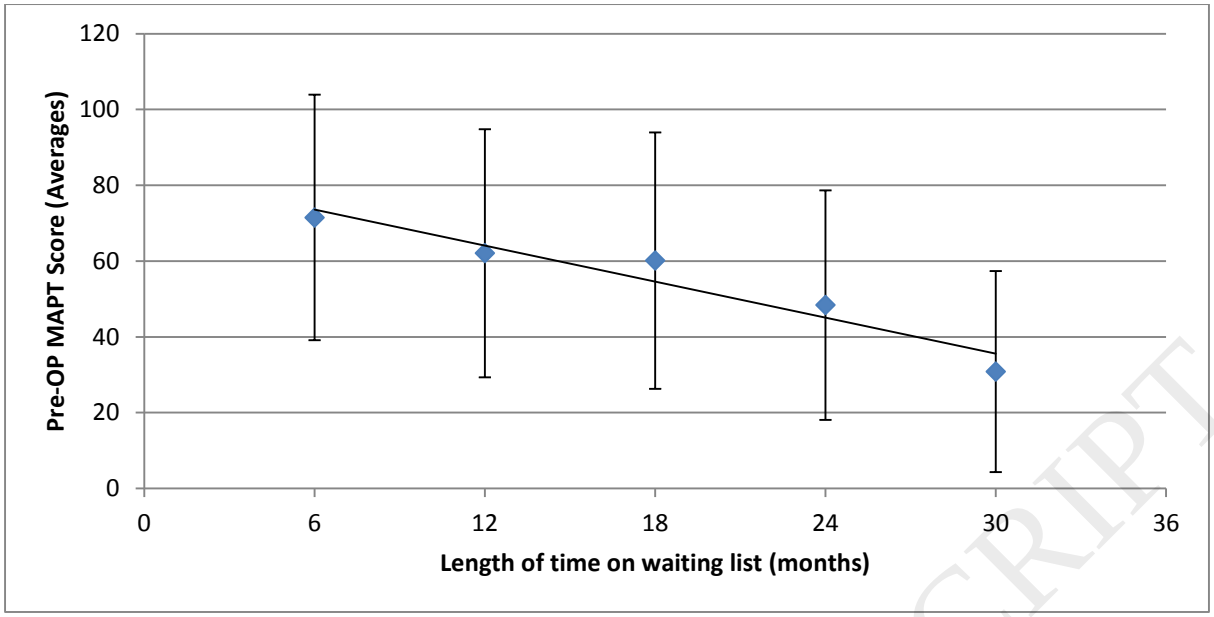

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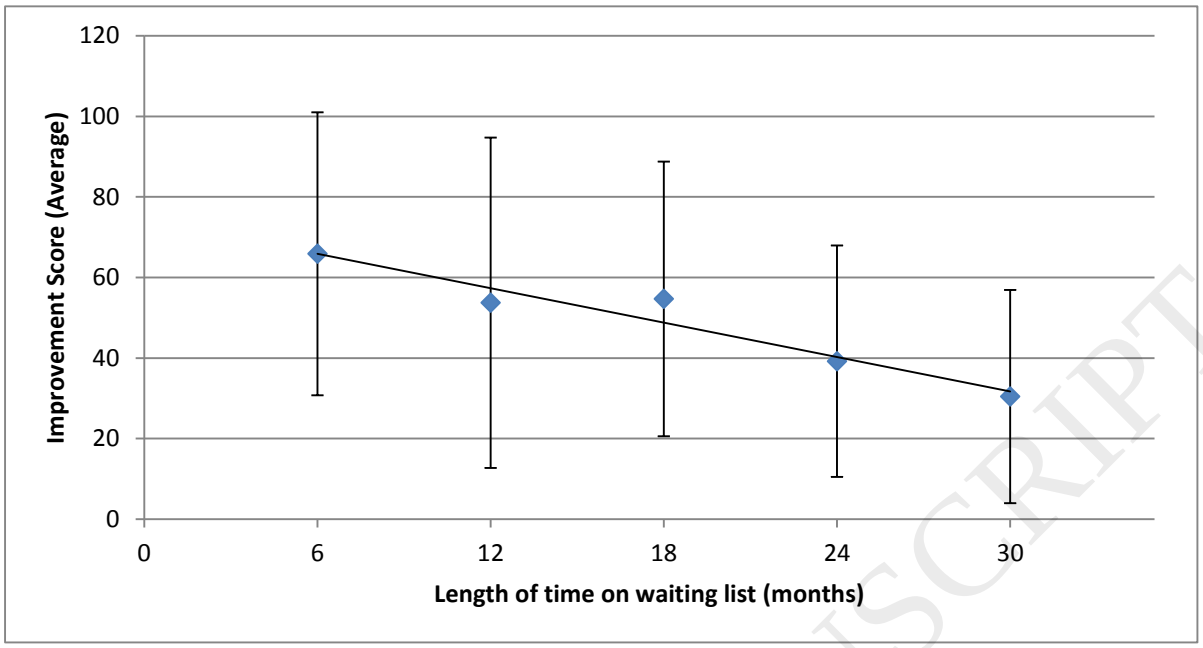

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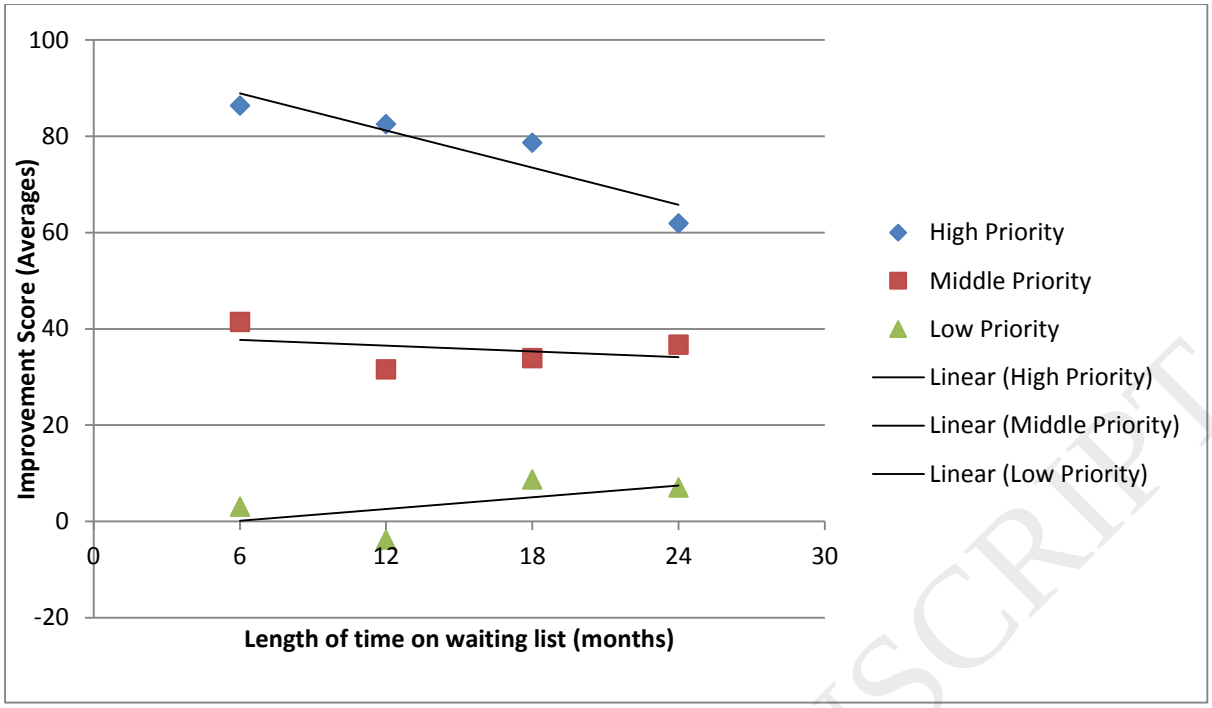

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