

An audit to measure >5% reduction efforts in weight in patients suffering from Osteoarthritis before their scheduled Total Joint Replacement at Darwen Health Link Surgery, Blackburn with Darwen



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Introduction

Approximately 240 million individuals worldwide suffer from osteoarthritis, a condition resulting in the inflammation of joints¹. Within the United Kingdom (UK), 8.75 million individuals have sought treatment for osteoarthritis². In the UK, arthritis is more common in women than men, with 5 million women seeking treatment for osteoarthritis compared to 3.5 million men². A population-based study in England found that the incidence of knee osteoarthritis was the highest, followed by the hip, and lastly the hand³. Interestingly, the local average for patients suffering from hip and knee osteoarthritis (11.7% and 19.8% respectively) in the Blackburn with Darwen municipality is higher than the national average of patients across England (10.9% for hip and 6.1% for knee respectively)⁴.

Osteoarthritis is the result of damage to synovial joints from the consequent repair to structural damage within joints⁵. Joint damage via injury and excessive loading over time cause changes in sub-chondral bone ligaments, synovial membranes, articular cartilage, and capsules⁶. These changes result in structural damage of the joint via surface fibrillation and ulceration with the loss of cartilage – exposing the underlying bone to more stress-producing microfractures, sclerotic subchondral bone and osteophytes^{6,7}. Long-term damage to synovial joints lead to localised loss of cartilage, remodelling of bone, osteophyte formation and synovitis⁷. Multiple predisposing factors are implicated in osteoarthritis, mainly including genetics, obesity, osteoporosis, trauma, occupation, congenital problems, and other musculoskeletal diseases⁶.

Clinical features of osteoarthritis primarily include mechanical pain, joint stiffness, loss of movement and reduced function⁸. The first lines of management include education of the patient, strategies for weight loss, therapeutic exercises, simple analgesia, and psychosocial support⁷. If symptoms are persisting; referral to physiotherapy, occupational therapy, podiatry, and musculoskeletal clinics are warranted⁷. However, if individuals continue to suffer with longstanding functional limitations, severe pain and are resistant to non-surgical treatment or have atypical symptoms, referrals to an orthopaedic surgeon for joint replacement are strongly considered⁷.

The correlation between a high body mass index (BMI) and the incidence of osteoarthritis is well-established. A population-based longitudinal study identified that those with a higher baseline BMI had significantly higher incidence of radiographic knee osteoarthritis⁹. A cohort-study analysed baseline weight in 1420 men between 1948 and 1951 and followed them up for 40 years later till 1983 to 1985¹⁰. They reported that the men in the highest quintile of

weight had an increased risk of developing radiographic knee osteoarthritis than those in the lightest quintiles of weight¹⁰. However, obesity is not limited to radiological osteoarthritis, as it predicted the development of knee pain independent of radiological changes¹¹. The effect of obesity on osteoarthritis is a complex interaction of genetic, mechanical, and biological factors¹². Mechanically, there is more stress on a weight-bearing joint due to excess weight load in obese individuals¹³. This load can stress the articular cartilage causing degenerative changes, as mentioned before¹⁴.

Adipose tissue has also been pointed out in the production of increased levels of hormones and growth factors leading to articular cartilage breakdown¹⁵. An association between increased insulin-like growth factor 1 (IGF1) and osteoarthritis of hand and knee has been highlighted, however no association between IGF1 and hip arthritis was reported¹⁶. Conversely, another study found reduced IGF-1 levels in patients with symptomatic osteoarthritis¹⁷. Furthermore, adipose tissue has been shown to produce higher levels of proinflammatory cytokines and adipokines, increasing the production of cartilage-degrading enzymes and neuropeptide release, which is involved in regulating appetite and cartilage homeostasis¹⁸. Considering the conflicting reports and studies, more research is needed to discern the physiological modus operandi through which obesity impacts osteoarthritis. This is necessary to not only elucidate the mechanism through which osteoarthritis transpires, but also pave a way for producing more targeted therapeutics.

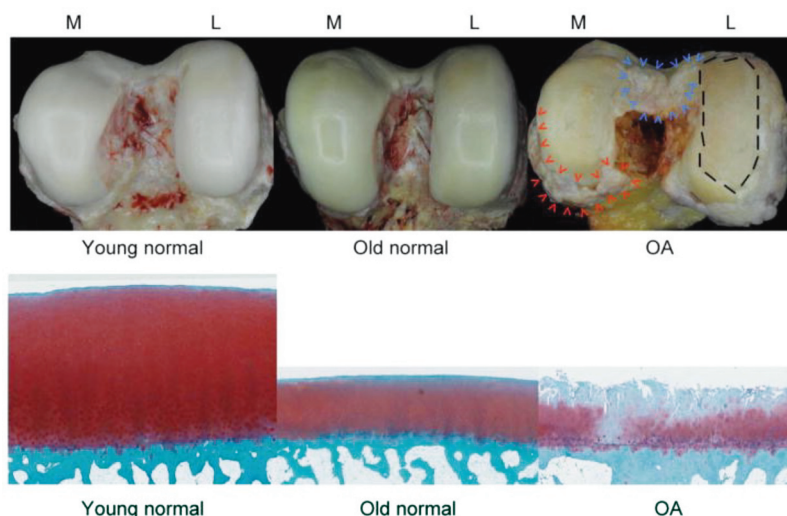


Figure 1: Images represent normal young (left, age 40), normal aging (centre, age 76) and osteoarthritic (right, age 88) tissue. The yellow discoloration on the condyles of the 'old normal' are in part due to the formation of advanced glycation end products (AGEs). The osteoarthritis sample on the other hand features large areas with complete loss of articular cartilage as represented by the dashed line on the left femoral condyle, osteophytes at the joint margins (as indicated by red arrowheads) and the intercondylar notch (pointed out by the blue arrowheads). M=medial; L=lateral. The stained sections of the condyles correspond to the macroscopic images of human condyles above¹⁹.

The above pictures highlight the impact Advanced Glycation End products (AGEs) have on joints as we age, which increase significantly through non-enzymatic glycation of proteins²⁰. Diabetes has also been strongly linked to the production of AGEs, alongside vascular endothelial growth factors and other cytokines - indicating that poor glycaemic control, whether diabetic in origin or not, may also be an insult to the joints²¹. Studies have shown that increased levels of AGEs can deteriorate articular cartilage through promoting stiffness, elevating chondrocyte-mediated proteoglycan degradation, decreasing proteoglycan synthesis and inducing the degradation of the extracellular matrix (ECM) of cartilage²². High sugar consumption, especially fructose, has been shown to promote accumulation of AGEs in various tissues in line with peripheral insulin resistance and dysregulated lipid metabolism²³. Although AGE formation is promoted by raised glucose levels in diabetes, the accumulation of AGEs in articular cartilage with ageing can be seen in non-diabetics¹⁹. This calls into question as to what other factors are potentially involved in cartilage breakdown. However, simultaneously we should also extend the link of osteoarthritis within established diabetics to insulin resistant non-diabetics - as the latter group of patients despite not being diabetic, most probably still carry the elevated glycaemic burden to yield the production of AGEs that go onto inflict articular damage, as noted above.

In a randomised control trial (RCT) lasting almost 5 years, 'exercise alone', 'exercise with diet' and 'diet alone' were applied to individuals suffering with osteoarthritis who had BMIs between 27-41²⁴. The study found that among obese individuals with knee osteoarthritis, losing just 10% of baseline bodyweight significantly alleviated symptoms of pain and discomfort²⁴. In addition, participants in the 'diet with exercise' and the diet-alone group had more weight loss and greater reductions in pro-inflammatory cytokines, like IL-6, than those in the exercise-alone group. Also, those in the diet group had greater reductions in knee compressive forces as compared to those in the exercise group²⁴.

Another study analysed data from 240 overweight and obese patients, most of whom were elderly suffering with painful osteoarthritis of the knee²⁵. The Cohort study assessed the efficacy of diet and exercise to bring about weight loss and subsequent improvement in symptoms amongst these patients. The authors noted that those who lost 20% or more of their body weight had significantly less inflammation than those who lost 5% or less. The former group of participants also reported less pain, markedly-improved ability to walk farther and even better mental health than those in the latter group - who had only lost 5% or less of their baseline bodyweight²⁵. Hence why the National Institute of Clinical Excellence (NICE) recommends that individuals with osteoarthritis try to lose at least 5% of their weight but emphasises on why achieving the 10% target (and beyond) would yield better outcomes. These studies also highlight that clinicians need to underscore the importance of diet to patients when counselling them to lose weight, and that exercise would be beneficial, but not essential⁷.

Multiple individuals who experience osteoarthritis often undergo joint replacement surgery/total joint arthroscopy for treatment. A meta-analysis shed light on how high-BMI patients who have undergone knee replacements are at a greater risk to develop post-operative infections and other complications, aside from having a longer operation than normal-BMI patients undergoing similar procedures²⁶. In addition, obese patients were found to exhibit less functionality of their joints, more pain post-operation, higher chances of developing deep vein thromboses (DVTs), as well as being more likely to have revisions of their knee replacements^{26, 27}. Another study looking specifically at infection rates concerning knee operations in individuals

with BMI>30 versus those with a BMI<30, clearly indicated that the former group had poorer skin blood supply and an odds ratio of 4.2-6.7 of developing infections²⁸. Hence being overweight/obese can actively cause and worsen osteoarthritis, and even affect treatment via complications from joint replacements. In conclusion, weight loss in obese patients can have a multitude of positive effects, specifically improving quality of life, pain, and physical functionality in those with osteoarthritis.

Audit rationale

It is estimated that if current trends regarding obesity and being overweight continue, approximately 71% of the UK's adult population will either be overweight or obese by 2040²⁹. As more individuals experience obesity, they are bound to experience complications with osteoarthritis. It is imperative to reduce the burden of osteoarthritis to prevent disability, poor quality of life, pain, and loss of physical functionality. One of the ways to achieve that is via weight loss. According to evidence-based recommendations of NICE, any weight loss is effective but losing 10% or more of body weight is likely to achieve better therapeutic effects in those with osteoarthritis⁷. Consequently, this audit aims to examine NICE recommendations on osteoarthritis and weight management.

Aim

This audit aims to measure Darwen Health Link's adherence to NICE guidelines 226 "Osteoarthritis in over 16s: diagnosis and management" for the management of patients with osteoarthritis regarding weight loss.

Objectives

1. Investigate what percentage of patients were given diet and exercise education by GPs during their first presentation with osteoarthritis as per NG226.
2. Investigate what percentage of patients achieved a minimum of 5% weight loss prior to a total hip or knee replacement as per NG226.

Methodology

Criteria and Standards

NICE Criteria (NICE, 2022)	Standard	Guidance
1. Patients with osteoarthritis (with BMI over 30) are offered some sort of weight loss advice (at least 3-12 months before their respective surgeries) as part of conservative management.	100%	NG226 1.6.1
2. Patients with osteoarthritis (with BMI over 30) to have achieved some weight loss (by at least 5% within 3-12 months before their respective surgeries) as part of conservative management.	50%	NG226 1.3.5

Table 1: N.B. the criteria have been modified with the addition of certain data above, as seen in the parentheses above. Please see methodology for further explanation.

The audit was carried out using data derived from a total of 57 patients registered at Darwen Health Link Centre between November (2021) to November (2022). All these patients underwent hip and/or knee surgeries within this period and were evaluated against NICE Guidelines 226 (NG226) to determine whether adequate pre-op advice was given. All the relevant medical information was ascertained from the EMIS Web database or from patients directly via telephone calls.

The results were either 'pass' or 'fail' for matching (or not) the criteria, which were then used to calculate the percentage of patients fulfilling them. The following diagram outlines the search process used to derive the number of patients based upon the inclusion and exclusion criteria (Fig 2).

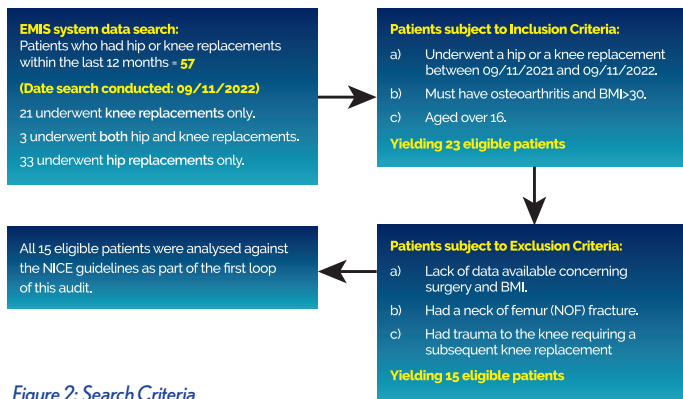


Figure 2: Search Criteria

Qualitative and quantitative data were ascertained by conducting individual searches through patient notes on the Egton Medical Information System (EMIS) database. Qualitative data regarding the assessment of all patients undergoing hip/knee replacements, whose BMI was more than 30, to check if guidance to lose weight had been offered or not. 'Diet Health Education' is the often-used EMIS system code to reflect that, meaning if this was present in the consultation notes, a 'pass' would be granted for the first criterion from NG226. For the second criterion to be fulfilled, the very same group of patients were required to have lost at least 5% of their weight within 3-12 months prior to their surgery. Despite NICE guidance (2022) stipulating a period of 3 months to afford for 5-10% weight loss (ideally 10%), the lower boundary of weight loss requirement and greater amount of time was afforded to the practise to achieve the goal. As such, there was no specific BMI threshold that the guidelines ordained which the patients should be below to be eligible for surgery. However, a BMI of 30 was used by the authors of this audit as a target to identify patients with osteoarthritis who would benefit the most from weight loss.

NICE Criteria (NICE, 2022)	Standard	Practice Compliance	Guidance
1. Patients with osteoarthritis (with BMI over 30) are offered some sort of weight loss advice (at least 3-12 months before their respective surgeries) as part of conservative management.	100%	100%	NG226 1.6.1
2. Patients with osteoarthritis (with BMI over 30) to have achieved some weight loss (by at least 5% within 3-12 months before their respective surgeries) as part of conservative management.	50%	20%	NG226 1.3.5

Table 2: Results based on NICE guidelines against their appropriate standards.

8 patients underwent a knee replacement and 7 had hip replacements, respectively. All (100%) of the patients were given advice concerning weight management during the time leading up to the operation. However, only 20% were able to achieve the minimum of 5% weight loss from their baseline. Average weight loss of 5.2% was achieved by all the patients who did lose weight; however, this accounts for patients who lost weight but not 5% or more circa their respective surgeries. Across the 15 patients, a mean average of 3% addition in weight took place from their baseline, up till their surgery.



Patient Number	Hip or Knee or both	Weight at 3-12 mths circa surgery (kg)	Weight at surgery (kg)	BMI at time of surgery (kg)	Diet health education given by the GP per NG226 (Pass or Fail)	Difference in weight (%gain + or loss -)	Min 5% weight loss achieved by the GP per NG226 (Pass or Fail)
1	Knee	67	75	31.2	Pass	+11%	Fail
2	Knee	113	113	36.1	Pass	0	Fail
3	Hip	105	95	32.5	Pass	-9.5%	Pass
4	Hip	86	89	31.9	Pass	+4.2%	Fail
5	Knee	105	104.5	32.2	Pass	-0.50%	Fail
6	Hip	91	89	30.1	Pass	-2.2%	Fail
7	Knee	85	89	31.5	Pass	+4.7%	Fail
8	Knee	80	81	31.6	Pass	+1.25%	Fail
9	Hip	116	117	38.2	Pass	+0.9%	Fail
10	Knee	118	110	33.4	Pass	-6.8%	Pass
11	Hip	87	87	31	Pass	0	Fail
12	Knee	96	96	39	Pass	0	Fail
13	Hip	105	97	31	Pass	-8%	Pass
14	Hip	93.7	99.5	36.2	Pass	+6.2%	Fail
15	Knee	85	122	49.5	Pass	+43.5%	Fail
Results					100% Pass Rate	20% Pass Rate	

Table 3: Complete breakdown of all the 15 patients' weight management before and at the time of surgery, their respective BMIs and whether they gained or lost weight (in percentage), as well as an assessment of the provision of weight loss advice from the GPs.

Discussion

Strengths, Weaknesses and Evidence

100% of clinicians document diet and exercise advice given to patients at or around the time of referral to orthopaedics. It reflects the clinicians' attempt to treat patients holistically in addition to providing symptomatic relief. It also shows that they take responsibility for patients' weight management instead of delegating it to the orthopaedic surgeons. GPs realise that adequate weight loss is not always possible, and that it may become a frustrating ultimatum of some sort for referrals - if guidelines are followed to the word. Therefore, considering the desperate situation of patients, GPs use the long waiting times before seeing an orthopaedic surgeon as an opportunity for patients to manage their weight, as the clinic appointment or even the elective surgery (if established) acts as an incentive. Unfortunately, despite the diet and exercise education being given at a 100% success rate, only 20% of patients achieved the required weight loss. This may be due to a multitude of reasons as explained.

All patient notes had the statement 'diet and exercise education' to represent the documentation of weight loss advice. However, no clinician elaborated on the exact contents of the discussion, making it difficult to judge the quality of education provided. It may be concluded that due to poor quality of diet and exercise education, patients may not have understood the significance of losing weight and thus, were unsuccessful. Upon speaking to a patient who did not achieve weight loss, she mentioned that she was unable to recall any education about it, conveying that the education may not have been properly emphasized. It is also important to acknowledge that due to time constraints of a consultation, it is difficult to cover medical management, psychological interventions, and weight loss management in a single 10-minute appointment.

A qualitative analysis found that most weight loss advice given by GPs is often superficial, following a general "eat less do more" approach³⁰. This oversimplistic understanding of weight management is largely promoted by the NHS and mainstream medical establishments; highlighting the point of poor-quality education and perhaps the

encouragement of an all too familiar approach that has consistently failed to deliver. One of the senior GPs at the practice acknowledged the need to be flexible in utilising different approaches for weight loss and in fact encouraged in applying a more dynamic and open-minded methodology. Therefore, considering the clinical experience of clinicians and the best available evidence, the authors decided to intervene with a weight loss pack promoting the ketogenic diet.

The literature supports ketogenic diets as being effective in promoting weight loss and improving overall metabolic health³¹. In fact, a combination of 67 RCTs published from 2002 to 2020 comparing ketogenic diets to 'low fat' (LF) diets (total n=5618) found that 58 out of the 67 studies showed ketogenic diets were superior to LF diets in promoting weight loss, whilst only 7 studies showed the LF ones to be better – with 2 RCTs being equal³². Furthermore, 36 out of the total RCTs reported the ketogenic diets to be significantly ($p<0.05$) better in aiding weight loss, yet none of the LF ones were shown to be significantly better than the ketogenic diets³².

Importantly, when applied in the context of osteoarthritis, ketogenic diets have shown to be useful in ameliorating inflammation and improving clinical performance. In a study comparing the ketogenic diet against a standard diet in rats induced with osteoarthritis, the former was significantly better in reducing damage to articular cartilage and subchondral bone³³. Furthermore, a 12-week long study compared the ketogenic diet, low-fat diet and a control diet in adults aged 65-75 with knee osteoarthritis³⁴. The ketogenic diet was reported to significantly reduce oxidative stress and the adipokine leptin compared with the other two regimes, and alleviate functional pain³⁴. Another prospective study followed type-2 diabetics with osteoarthritis receiving the ketogenic diet (n=173) and 'usual care' (n=69)¹⁴. After 2 years of follow-up, participants receiving the ketogenic diet had significantly ($p<0.05$) better Knee injury and Osteoarthritis Outcome Score (KOOS), with patients reporting marked improvement in knee function¹⁴. The study acknowledged that the improvement in KOOS was most likely explained by the reduced central adiposity and inflammation, explaining the diet's success¹⁴. This study highlights that the ketogenic diet is effective and practical over long term, and that too in patients with other more common comorbidities like diabetes, obesity, and metabolic syndrome. Such data also raises an important question about the efficacy of ketogenic diets in patients who may not be obese but are exhibiting signs of insulin resistance or poor metabolic health. I.e., if studies have been shown to improve pain and functionality in osteoarthritic patients who are obese through not only the bio-mechanical pathway (pure weight loss), but also through the bio-chemical approach (via reducing the inflammation), then an argument can be put for advocating this diet for patients of osteoarthritis who may not be obese. However, more research is needed to explore the impact of ketogenic diets in that subgroup of patients.

Only 20% of patients achieved weight loss of 5% or more, which was lower than the designated 50% standard. It is difficult to comment on the performance due to the lack of data available on the percentage of obese patients with osteoarthritis, losing adequate weight before their respective surgeries. Hence the application of a modest and neutral standard of 50% for that criterion. This may call into question the reproducibility of the project, perhaps more so if to be conducted at other institutes. Yet simultaneously this can be advantageous for the audit as it can attempt to contribute this performance as some form of baseline data for literature concerning patients with osteoarthritis and a high BMI. Additionally, it is important to note that from all 15 patients analysed, two did achieve significant weight loss, however their BMI remained >30 and were unable to bring it down within the 12 months leading up to their respective surgeries. However, they had

lost a significant amount of weight well before 12 months of their surgeries, as their EMIS records indicated. This alludes to a potential weakness of the audit as it failed to acknowledge weight loss before the 12-month designated period leading up to the surgery.

In addition, the first part of this audit only focused on patients scheduled to receive a surgical intervention for osteoarthritis. This was done as those who were recommended for surgeries, were the individuals who were suffering from the most severe osteoarthritis, hence warranting joint replacements. Therefore, it would be reasonable to posit that GPs must have utilised the more aggressive weight loss measures as part of conservative management. However, upon discussion with one of the senior GPs, despite the reasonability of the theory in applying the more aggressive conservative treatment protocols in such severe cases; both the GPs and patients eventually come to a standstill in attaining anymore clinical improvement through conservative protocols. As a result, the GPs become compelled to refer such patients with debilitating osteoarthritis to the orthopaedic surgeons, despite not having achieved adequate weight loss. This makes the audit unique in its nature as it aims to address the problems of a potentially surgical patient within a primary care setting.

No specific weight/BMI is mentioned by NICE guidance as the 'limit' beyond which surgery is non-viable. Regarding the selection of BMI >30 as part of the inclusion criteria, this was derived from a discussion with the senior GP. The cut-off weights/BMIs vary largely depending upon the clinician, institutional guidelines, and the clinical status of the patient. However, the more 'obese' a patient is considered, the more concerned the surgeon becomes about the peri and post-op complications as alluded to in the introduction. Hence why BMI target representing 'obesity' (i.e., over 30) was designated to adequately represent patients with osteoarthritis who would have been struggling with their weight management.

By motivating patients to lose even 5% of their baseline weight, patients can achieve vast symptomatic and structural improvement in their symptoms and consequently avoid surgery^{35, 36}. Benefits of weight loss are evident, but it is important to shed light on why it improved symptoms of osteoarthritis. Not only will it then give a better understanding of osteoarthritis as a clinical disease, but also allow a more targeted approach to both patients and doctors. An RCT showed that even one pound of weight loss was associated with a four-fold reduction in mechanical force on the knee joint³⁷. In addition, a meta-analysis highlighted that weight loss correlated with reduction in levels of pro-inflammatory markers such as c-reactive protein, interleukin 6 and tissue necrotising factor³⁸. Inflammation through these cytokines has been implicated strongly in catalysing the process of osteoarthritis¹⁵, which makes weight loss a reasonable treatment protocol. Therefore, our public poster (Appendix 1) was designed to convey that osteoarthritis transpires through physical damage to the cartilage through excess load (weight) and via the inflammatory cytokines, in order that the public understands from both ways the benefits of losing weight.

Recommendations

- 1) Targeted weight loss poster (Appendix 1) to be attached onto weighing scale at reception of practice to encourage opportunistic weight measurement by patients. This measurement will be added to patient EMIS records which will allow for accurate assessment of BMI and consequent weight loss. Additionally, it encourages patients to understand their pain from osteoarthritis from a biomechanical and biochemical pathway, as they are prompted to book an appointment with their GPs.
- 2) Detailed weight loss advice pack (Appendix 2) to be given to

patients in copy, online or sent via text to all patients with a BMI>30 who are awaiting joint replacement surgery. This will aim to address myths about diet and exercise, give practical and specific advice about diet swaps, provide space for weight monitoring, and lastly address the benefits of weight loss for osteoarthritis.

3) GPs to offer referral to local 12-week weight loss programme to all patients with a BMI>30 who are awaiting joint replacement surgery, and any new patients who present for osteoarthritis with a BMI of >30.

Barriers

These recommendations were implemented in the second week of December 2022. A reaudit of weight loss in patients will be conducted in March 2023, after 3 months have elapsed to assess the efficacy of the intervention.

Despite the guidance from NICE, each doctor has their own style of assessment and treatment which aims to apply a biopsychosocial approach. Therefore one of the potential barriers to the project could be the differences between the clinician's thought process and the intervention itself. Also some may not be aware of the project in place, and thus not provide the weight loss pack. Moreover, weight loss is complex and needs continuous support from various stakeholders. Therefore, if supervision is lacking, patients may not be complying to the recommendations adequately, making the results potentially unreliable. Patients may also find this a tough regime to abide by, as it does require them to lose foods that they would have otherwise been consuming daily. The weight loss pack does acknowledge this and offers alternative healthier recipes (see appendix 2); however, it can dissuade the patients from following the regime properly. In addition, patients may have been given some other advice concerning weight loss and so may be confused when applying this intervention. Especially considering the mainstream guidance of avoiding fats, which the intervention is in complete opposition to. Lastly, the designated period of intervention implementation is 3 months - which can be argued as somewhat insufficient especially when the first audit loop is allotting a 3-12-month period of weight loss achievement circa surgery. Perhaps a longer timeframe is needed to establish patients on the diet properly and have the clinicians become accustomed to it.

Conclusion

Obesity is projected to affect a large proportion of the population, with those suffering from osteoarthritis suffering further due to their obesity. Hence, it is imperative to tackle obesity at grassroots level before it becomes a more significant problem. Managing obesity in osteoarthritic patients can guarantee better surgical outcomes, better functionality, less pain, and perhaps even mitigate the need for surgery. Considering this, the audit showed that Darwen Health Links adherence to the NICE guidelines 226 "Osteoarthritis in over 16s: diagnosis and management" is suboptimal for effective weight loss.

The main attributable causes are the complex nature of weight loss, limited time for GP appointments, lack of structure in giving advice, poor documentation, and patients being refractory to treatment. To overcome the problems, the authors have implemented a targeted poster, a weight loss pack recommending the ketogenic diet, and a referral to a local weight loss programme.

The impact of obesity on both patients and healthcare systems are debilitating. By implementing measures to curb obesity early in the patient journey at primary care, we hope to prevent the most challenging consequences of obesity on osteoarthritis, namely pain, disability and perhaps surgery.

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