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CrossFit Participation and Medication Use: Observations from a UK Population Survey

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Abstract

Chronic diseases, responsible for 74% of global mortality, impose a substantial health burden. This study investigates the perceived effects of CrossFit, a form of functional training, on medication use in the UK population. The research aims to provide insights into how CrossFit might relate to medical interventions for individuals with long-term health conditions. The study, encompassing 1,211 UK residents (over 18yrs.) recruited via CrossFit Affiliates, involved a 14-question online survey covering information pertaining to participants' training background, medication use, medical interventions as well as specific comments relating to the impact of CrossFit on participants overall health. Following engagement in CrossFit training, a 54% reported reduction in medication usage was observed. This included 69 participants discontinuing medication and 82 reporting significantly reducing medication use within the first 6 months. Younger age groups (20-39 years) showed greater medication

reduction, with 43% of those aged 20-29 reducing medication by over half and 27% eliminating it entirely. In the 30-39 age group, 29% eliminated medication and 20% reduced it significantly. Older age groups also saw reductions, though less pronounced. A Spearman's rank correlation identified a strong positive correlation between age and reductions to medication usage r(1137) = 0.110, p = 0.001. Further analysis of CrossFit training history indicated that neither CrossFit training age, nor CrossFit training frequency impacted perceptions of medication usage (r(1137) = -0.051, p = 0.085 and r(1137) = -0.043, p = 0.150) suggesting that participants did not need to be experienced or frequent CrossFit participants to experience the perceived benefits when it came to reducing medication use. Antidepressants, asthma inhalers, and painkillers were the most common medications used. Forty percent of all participants also reported fewer medical appointments, with this figure rising to 43% among those who were on medication before starting CrossFit. CrossFit training years and training frequency did not significantly correlate with whether participants reduced medical appointments or not (r(1137) = -0.034, p = 0.248, r(1137) = -0.032, p = 0.275) indicating that neither training history nor frequency impacted the perceived benefits of CrossFit training when associated with medical intervention. Seventy-one respondents reported cancelling or postponing surgeries due to the benefits of CrossFit, of these 55% reported reduced symptoms and 31% reported no longer needing surgery. A chi-squared test was conducted to explore the relationship between session frequency and medication reduction, which suggested a potential association; however, the result was not statistically significant (χ^2 = 12.72, df = 12.59, p = 0.10). Overall, CrossFit participants reported reduction in medication usage, medical appointments, and surgical intervention needed.

Keywords
Chronic disease; physical activity; evaluation; impact; ageing; health; exercise; functional fitness; CrossFit

1. Introduction

Chronic diseases, which develop gradually and persist over time [1], are a major global health issue, responsible for approximately 41 million deaths annually-about 74% of total global mortality [2]. These diseases are the leading causes of death worldwide [3]. In the United Kingdom, the ageing population further increases the prevalence of chronic diseases, which often become more common with age and can develop silently over many years [1]. Currently, 26 million people in the UK have at least one chronic condition, and an additional 10 million have two or more [4], affecting nearly half of the population. This high prevalence of chronic diseases significantly impacts the healthcare system, with chronic disease patients accounting for half of all GP appointments and 70% of inpatient hospital beds. This places considerable financial pressure on the National Health Service (NHS), as a large portion of its budget is devoted to managing these conditions and improving patient quality of life. Therefore, it is crucial to invest in research into preventive strategies to better allocate resources and address this challenge.

One such mechanism of managing disease risk is through appropriate manipulation of lifestyle factors which lead to chronic disease. Lifestyle risk factors include physical inactivity, sedentary behavior, smoking, alcohol consumption, and dietary choices, which collectively bear the blame for the escalating prevalence of chronic diseases [5]. Of the lifestyle factors, physical inactivity has gained interest due to the relationship between sedentary behavior and overall disease risk. Alarmingly, one in five individuals remains physically inactive, placing them at elevated risk for obesity, cardiovascular disease, diabetes, and other chronic diseases [6]. The well-established association between physical inactivity, sedentary behavior, and chronic disease predates contemporary research, with work by Morris et al. [7] illuminating the increased cardiovascular disease risk among sedentary individuals compared to their physically active counterparts. This association has been consistently reaffirmed across various occupational contexts [8, 9] and age groups [3, 10], emphasizing the pivotal role of physical activity as a determinant of health. These findings underscore the imperative need for healthcare systems to adopt proactive strategies that prioritize prevention.

Engagement in physical activity has also been associated with reducing the economic burden of disease, in which several studies have noted a decrease to healthcare costs following the implementation of regular physical activity programs. For example, Kang and Xiang [11] demonstrated that individuals engaging with recommended physical activity guidelines reduced costs associated with inpatient, emergency, and home health care, compared to those who are physically inactive [11]. In addition, De Boer et al. [12] reported that in the Netherlands, 0.4% of the total populations health care costs could be decreased, by a 1% increase in engagement with physical activity guidelines [12]. Additional studies have also reported on reducing pharmaceutical costs (see Vagnoni et al. [13]) and out of pocket costs (see Dallmeyer, Wicker & Breuer, [14]). Compared to other interventions targeting smoking cessation and weight, engagement in physical activity has been shown to result in a saving of 17.7% in terms of out-of-pocket health care costs if participants engage with activity at least once per week [14]. For smoking cessation and weight loss programs, out of pocket health care savings are equal to 10.3% and 11.4% per annum respectively.

Whilst some papers have discussed physical activity in relation to broad activity guidelines few have attempted to investigate the impact of specific programs or exercise modalities in relation to reduction of disease risk and perceptions of health care usage. Notably, functional training emerges as a promising approach to mitigate chronic diseases and enhance health and well-being. By definition, functional training uses functional multi-joint movements which replicate day to day activities, in both an aerobic and muscle-strengthening capacity [15]. This training paradigm tailors exercise regimens to individual capabilities, accommodating limitations while fostering effectiveness [16]. Functional training has demonstrated benefits encompassing cardiovascular and metabolic health, cognitive function, and overall mortality reduction, along with improvements in body composition, such as lean and fat mass, body fat percentage, and glucose regulation [17]. These enhancements, especially in strength and mobility, prove invaluable for individuals afflicted by chronic diseases, often experiencing compromised mobility and functionality in daily life [17]. One widely recognized form of functional training is CrossFit™.

CrossFit, characterized by its emphasis on functional training, represents one of the fastest-growing fitness methodologies globally [18]. CrossFit offers a plethora of physiological, psychological, and social benefits. Experienced CrossFit practitioners exhibit superior aerobic capacity and anaerobic power compared to novices [18]. The structured nature of CrossFit programs,

replete with movement guidance and community integration, renders CrossFit an ideal choice for individuals seeking to improve their health through exercise [19]. Participation in CrossFit gyms yields additional advantages, as these facilities offer structured programs with movement instruction and injury prevention measures, contributing to higher adherence rates [20]. The communal aspect of CrossFit fosters a sense of belonging and mutual support, promoting adherence and motivation [18, 21]. CrossFit's inclusivity, accommodating individuals of varying skill levels, enhances its appeal, promoting the formation of new social bonds and relationships [21]. The culture of healthy competition, both with peers and oneself, further bolsters motivation and success [18, 21]. Noteworthy examples in the UK include FiiT for Life, a gym catering to individuals with chronic diseases seeking to become more active within their communities, and On-Ramp programs, which enable nurses to recommend patients to find gyms and book classes at CrossFit facilities [19]. Despite its potential, research investigating the effects of CrossFit on the chronic disease population remains limited and warrants exploration. Furthermore, no studies to date have investigated the effects of CrossFit on long term health and perceptions of health care usage. This is an area that warrants further investigation, noting that previous studies have identified fitter individuals generally report less of a need to access health care services and pharmaceuticals. Given that CrossFit results in greater adherence and involves a high social element compared to other exercise methodologies, it seems reasonable to suggest that it will likely result in reduced medication usage and reduced disease risk as a by-product of frequent engagement.

1.1 Aims

The primary objectives of this study are twofold: first, to evaluate the incidence of medical conditions within a CrossFit population and second to establish the relationship between CrossFit participation and medical intervention. This investigation seeks to shed light on the effectiveness of physical activity programs, specifically CrossFit, in managing chronic diseases. Additionally, this research aims to explore whether CrossFit participation is associated with changes in medication use, healthcare costs, and morbidity risk within the general population and the NHS.

2. Materials and Methods

2.1 Participants and Procedures

The data for this study was derived from a survey conducted by CrossFit UK, the research team were granted permission to utilize the data for analysis. The original inclusion criteria required participants to be registered members at a UK CrossFit affiliate. Consent for the inclusion of the data in the research was obtained from the third-party entity responsible for data collection, namely CrossFit UK. The study involved 1,211 UK residents (mean age ± standard deviation, 37.5 ± 10.07 years) from across over 600 UK CrossFit affiliates. Recruitment efforts were executed through diverse channels, including email invitations via affiliates, affiliate social media platforms (e.g., Facebook, Instagram, Twitter), and advertisement placement within the CrossFit Newsletter. CrossFit participants provided their responses through a 14-question online survey covering training background, medication use, medical interventions, as well as additional information on the impact of CrossFit on their health. The utilization of these data was carried out in accordance with the guidelines and permissions granted by CrossFit UK, ensuring adherence to ethical standards and

data protection protocols. Participants retained the autonomy to withdraw from the study at any point during the completion of the survey, incurring no repercussions. Responses featuring incomplete answers were excluded from the subsequent data analysis. Data provided by the 3rd party was gathered anonymously and was stored in accordance with the Nottingham Trent University Data Management Plan for this study. Ethical approval was granted by Nottingham Trent's non-invasive ethics committee.

2.2 Design

The survey employed a self-report structure and comprised four distinct sections. The initial section collected demographic data and delved into participants' training backgrounds, encompassing three questions pertaining to age, training experience (in years), and the weekly training hours. The second section featured five questions, three of which employed a deductive approach, exploring participants' medication usage. The information encompassed whether participants were currently using medications, the specifics of their medication regimen, the duration of medication usage, and whether CrossFit had influenced a reduction in medication consumption. The third segment probed into participants' medical treatment experiences, comprising five questions, with four following a deductive approach. These questions addressed the impact of CrossFit on the frequency of medical appointments, any instances of surgery or medical interventions being cancelled or postponed due to CrossFit, details surrounding these procedures, the duration of time spent on medical waiting lists, and the way CrossFit contributed to the acceleration, deferment, or cancellation of surgeries/medical interventions. The concluding part of the survey consisted of a single open-ended question, enabling participants to furnish additional information and insights based on their experiences. In totality, the survey featured 14 questions.

Prior to the main data collection, a pilot test of the survey instrument was conducted with a small sample (n = 15) of participants reflective of the target population. This pilot test aimed to identify and address any ambiguities, inconsistencies, or unclear questions in the survey. The survey instrument also underwent a thorough review by subject matter experts in physical activity and health to assess its content validity and relevance to the research objectives. Feedback from experts was incorporated to refine the survey questions and ensure alignment with the study's aims. The survey questions were evaluated for content validity to ensure they adequately captured the constructs of interest. This involved comparing the survey items to existing literature [22, 23] and established measures in the field to confirm their relevance and comprehensiveness. In order to assess the stability of the survey instrument over time, a subset of participants (n = 24) completed the survey on two separate occasions, with an interval of 2 weeks between administrations. The consistency of responses between the two administrations was analyzed to determine the test-retest reliability of the instrument, which yielded a reliability coefficient of 0.85. This rigorous process was undertaken due to the limited research in this area, aiming to ensure the development of well-constructed and comprehensible survey questions in the absence of established validated measures from similar studies.

2.3 Data Analysis

All collected data were organized into four distinct categories corresponding to each survey section: training background, medication, medical treatment, and comments. The data in the first

three sections underwent statistical analysis using IBM SPSS (v.28). A Spearman's rank correlation analysis was employed to assess the impact of training years and weekly training duration on the outcomes of questions featuring deductive approaches. These questions encompassed the influence of CrossFit on medication usage, the reduction in medical appointments attributable to CrossFit, and the role of CrossFit in postponing or cancelling surgeries/medical interventions. The interpretation of correlation coefficients adhered to the following thresholds: 0 to 0.3 (or 0 to -0.3) denoting a weak positive (or negative) relationship, 0.3 to 0.7 (or -0.3 to -0.7) indicating a moderate positive (or negative) relationship, and 0.7 to 1 (or -0.7 to -1) signifying a strong positive (or negative) relationship. A chi-squared test was employed to determine the relationships between categorical variables, specifically examining the association between the frequency of training sessions per week and the reduction in medication usage. This test was chosen for its efficacy in identifying significant associations between categorical data. To conduct the analysis, observed frequencies of training sessions and corresponding medication reductions were compared against expected frequencies under the null hypothesis of no association.

The analysis of the final section, which allowed participants to provide comments and additional information based on their experiences, followed a rigorous and systematic approach. This section was crucial in capturing the qualitative insights and nuanced perspectives of the participants, complementing the quantitative data obtained through the structured survey. The analytical process employed a combination of inductive and deductive approaches to ensure the validity and comprehensiveness of the results.

2.3.1 Inductive Approach

Initially, an inductive approach was employed to extract raw themes from the participants' comments. This process involved a close examination of the text to identify recurring ideas, concepts, or topics that emerged organically from the participants' responses. Each comment was scrutinized to capture the essence of what participants were expressing without imposing preconceived categories or assumptions. Two experienced researchers conducted this phase of the analysis to ensure a thorough and unbiased extraction of raw themes. Once the raw themes were identified, the next step was to organize and interpret these themes systematically. This involved grouping similar raw themes together to form broader, more comprehensive categories. These categories or higher-order themes were created based on the inherent patterns and relationships observed among the raw themes. This process aimed to distil the richness of participant feedback into meaningful and interpretable insights.

2.3.2 Deductive Approach

In addition to the inductive analysis, a deductive approach was simultaneously applied to enhance the validity and rigor of the results. In the deductive analysis, predefined categories or themes were established based on existing theories, prior research, or key concepts relevant to the study's objectives. These predetermined categories served as a framework for analyzing the participants' comments and allowed for a structured examination of specific aspects of interest. Two experienced researchers also conducted the deductive analysis, ensuring consistency and accuracy in the application of the predefined categories.

The deductive analysis involved cross-referencing the predefined categories with the raw themes identified during the inductive phase. This process ensured that the participants' comments were not only explored in an open-ended manner but also assessed in relation to established theoretical or conceptual frameworks. The convergence of inductive and deductive analyses provided a comprehensive perspective on the data.

By combining these two complementary approaches-inductive and deductive-the analysis of the comments section aimed to strike a balance between capturing unanticipated insights and aligning findings with established theories or concepts. This methodological triangulation enhanced the robustness and credibility of the qualitative findings, making them more reliable for drawing conclusions and implications from the study. Ultimately, the dual approach facilitated a nuanced and holistic understanding of the participants' experiences, perspectives, and narratives, enriching the overall depth of the research findings. The analysis of the final section (comments) adopted an inductive approach employing a two-step process. Initially, raw themes were identified, followed by the subsequent organization and interpretation of these themes into higher-order themes. To bolster the validity of results, a deductive analysis was concurrently executed.

2.4 Ethics Statement

Ethical approval was granted by Nottingham Trent's non-invasive ethics committee to use the data in line with the permissions given by CrossFit UK.

3. Results

Table 1 and Table 2 illustrate the distribution of individuals across different age groups based on their experience with CrossFit. Notably, the majority of participants fell into the 30-39 (38%) followed by the 20-29 and 40-49 age groups, constituting 23% and 26% of the total respectively. It is interesting to observe a relatively balanced representation across the other age brackets, with the <19 age group accounting for 1% and the 50-59 and 60+ groups contributing 9% and 3%, respectively. These data suggest a diverse engagement with CrossFit across various age demographics.

Table 1 CrossFit Training Background of Participants.

Age (years)	How long have you been doing CrossFit?				
	Less than 6 months	6 months-1 year	1-2 years	2-4 years	4+ years
<19 (n = 13)	3 (23%)	2 (15%)	3 (23%)	3 (23%)	2 (15%)
20-29 (n = 272)	35 (13%)	62 (23%)	87 (32%)	47 (17%)	41 (15%)
30-39 (n = 460)	48 (10%)	59 (13%)	108 (23%)	111 (24%)	134 (29%)
40-49 (n = 317)	25 (8%)	35 (11%)	66 (21%)	67 (21%)	124 (39%)
50-59 (n = 106)	9 (8%)	11 (10%)	18 (17%)	26 (25%)	42 (40%)
60+ (n = 40)	6 (15%)	2 (5%)	7 (18%)	3 (8%)	22 (55%)
Total (n = 1208)	126 (10%)	171 (14%)	289 (24%)	257 (21%)	365 (30%)

Table 2 CrossFit Session Attended per Week.

Age (years)	On average how many times a week do you train?			
	Less than once a week	1-2 times a week	3-4 times a week	5+ times a week
<19 (n = 13)	0 (0%)	1 (8%)	4 (31%)	8 (62%)
20-29 (n = 272)	0 (0%)	25 (9%)	141 (52%)	106 (39%)
30-39 (n = 460)	3 (1%)	46 (10%)	240 (52%)	171 (37%)
40-49 (n = 317)	1 (0.3%)	25 (8%)	181 (57%)	110 (35%)
50-59 (n = 106)	0 (0%)	9 (8%)	67 (63%)	30 (28%)
60+ (n = 40)	0 (0%)	10 (25%)	27 (68%)	3 (8%)
Total (n = 1208)	4 (0.3%)	116 (10%)	660 (55%)	428 (35%)

3.1 CrossFit Training Background

Participants in this study exhibited diverse training experiences, with reported durations spanning from less than 6 months to over 4 years. Notably, 30% of all participants had engaged in CrossFit for 4 or more years. Examining the training frequency patterns provides insights into the commitment levels of individuals across different age brackets. Most participants, across all age groups, engage in CrossFit training 3-4 times a week, comprising 55% of the total population. The 5+ times a week category follows closely, representing 35% of participants. Unsurprisingly very few participants (0.3%) reported training less than once a week. The distribution appears consistent across age groups, highlighting a general trend of frequent and regular participation in CrossFit activities among respondents across age-groups.

3.2 Medication

Table 3. explores the presence of medical conditions among CrossFit participants before starting their fitness journey. Notably, a substantial majority (72%) did not report any pre-existing medical conditions, while 28% indicated having medical conditions prior to engaging in CrossFit. The average duration of medication usage among participants was in the range of 3 to 6 years (28%), with a smaller subset (6%) indicating long-term medication use exceeding 31 years (Table 3).

Table 3 History of Medication Use.

Age (years)	Medical conditions prior to starting CrossFit?		Of those that said Yes and responded (N = 244) How long have you been on medication?					
	Yes	No	0-2 years	3-6 years	7-10 years	11-20 years	21-30 years	31+ years
<19 (n = 13)	1 (8%)	12	0 (0%)	0 (0%)	0 (0%)	1 (100%)	0 (100%)	0 (0%)
20-29 (n = 271)	51 (19%)	220	12 (24%)	15 (31%)	5 (10%)	12 (24%)	5 (10%)	0 (0%)
30-39 (n = 460)	85 (18%)	375	9 (13%)	25 (37%)	11 (16%)	13 (19%)	10 (15%)	0 (0%)
40-49 (n = 316)	93 (29%)	223	15 (17%)	19 (21%)	22 (24%)	19 (21%)	4 (4%)	11 (12%)
50-59 (n = 103)	31 (29%)	74	1 (4%)	7 (30%)	5 (22%)	2 (9%)	5 (22%)	3 (13%)
60+ (n = 40)	19 (48%)	21	2 (13%)	2 (13%)	3 (20%)	5 (33%)	3 (20%)	0 (0%)
Total (n = 1205)	280 (28%)	925	39 (28%)	68 (28%)	46 (19%)	51 (21%)	27 (11%)	14 (6%)

It is noteworthy that only one of the participants under the age of 19 reported medication usage as would be expected. However, this was also the smallest number age group of respondents. Overall, most respondents (72%) commenced CrossFit without pre-existing health concerns.

Following engagement in CrossFit training, a substantial 54% of participants reported reduction in medication usage (Table 4). This reduction translated into 69 participants discontinuing medication altogether, while 82 participants reported a significant reduction in medication intake (Figure 1).

Table 4 Change in Medication usage.

Age (years)	No Change	Reduced by over half	Eliminated Completely	No Answer
<19 (n = 1)	1 (100%)	0 (0%)	0 (0%)	0 (0%)
20-29 (n = 51)	14 (27%)	22 (43%)	14 (27%)	1 (2%)
30-39 (n = 85)	28 (33%)	17 (20%)	25 (29%)	15 (18%)
40-49 (n = 93)	34 (37%)	31 (33%)	20 (22%)	8 (9%)
50-59 (n = 31)	12 (39%)	10 (32%)	6 (19%)	3 (10%)
60+ (n = 19)	11 (58%)	2 (11%)	4 (21%)	2 (11%)
Total (n = 280)	100 (36%)	82 (29%)	69 (25%)	29 (10%)

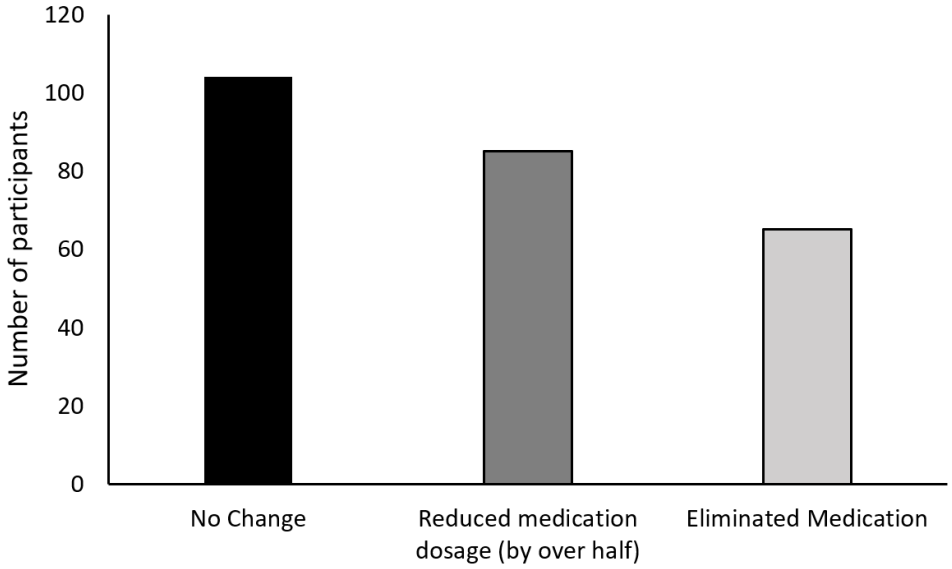

Figure 1 Change in Medication Usage.

The data suggests a correlation between participation in CrossFit® and changes in medication usage across all age groups. Among individuals aged 20-29, 43% reported reducing their medication by over half, while 27% indicated that they no longer needed medication. Similarly, respondents in the 30-39 age group showed encouraging results, with 29% reporting complete cessation of medication and 20% experiencing a reduction of over half. As the age groups progress, the percentage of individuals reporting medication reduction or cessation remains notable, albeit with slight variations. For instance, in the 40-49 age group, 33% reported a reduction of medication by over half, while 22% indicated complete elimination. This trend is observed across older age groups, with a noticeable decrease in medication dependency.

The findings indicate that younger age groups (20-39 years) are more likely to reduce or eliminate medication usage compared to older age groups (50+ years), where a higher proportion reported no change in their medication regimen.

Spearman's rank correlation was computed to assess for a correlation between CrossFit training years and changes to medication usage, and then number of training sessions per week and changes to medication usage. There was a moderate negative correlation between CrossFit training years and reductions to medication usage, r(1137) = -0.051 , p = 0.085 indicating that more years in CrossFit did not influence perceptions medication usage. There was also a weak negative correlation between CrossFit training frequency and perceptions of medication usage, r(1137) = -0.043 , p = 0.150. Spearman's rank correlation was computed to assess for a correlation between age and changes to medication usage. There was a strong positive correlation between age and reductions in medication usage, r(1137) = 0.110, p = 0.001, suggesting that participants' age may be associated with changes in their perceptions of medication usage. This is supported by the descriptive data outlined above.

A chi-square test was performed to assess the association between the number of CrossFit sessions per week and the reduction in medication usage. The analysis revealed no significant relationship between session frequency and medication reduction (X^2 = 12.72, df = 12.59, P = 0.10). However, participants attending more frequent sessions were more likely to report a reduction in their medication usage. These findings suggest that increased engagement in weekly sessions may play a role in reducing medication dependency.

3.2.1 Participant Medication

The survey revealed a diverse array of medication usage among participants. Notably, antidepressants were the most reported medication, with 29% of participants indicating their use. The second most prevalent medication category was inhalers for asthma, reported by 26% of participants. Painkillers for various conditions, injuries, and illnesses constituted the third most frequently reported medication category, used by 16% of participants. Participants also reported a range of other medications associated with chronic diseases such as diabetes, high blood pressure, and high cholesterol.

3.3 Medical Intervention

Participants were asked to report whether CrossFit had influenced the frequency of their medical appointments (Table 5).

Table 5 Reported Effects on Medical Appointments.

	Have you reduced the number of appointments with your medical professional since starting CrossFit				Has CrossFit led to you cancelling or postponing any surgeries or medical intervention?	
Age Group	Not at all	Neutral	Somewhat	Very much so	Yes	No
<19 (n = 13)	0 (0%)	9 (69%)	3 (23%)	1 (8%)	0 (0%)	13 (100%)
20-29 (n = 263)	30 (11%)	134 (51%)	45 17%)	54 (21%)	13 (5%)	251 (95%)
30-39 (n = 439)	56 (12%)	203 (46%)	80 (18%)	100 (23%)	22 (5%)	417 (95%)
40-49 (n = 308)	44 (14%)	141 (46%)	53 (17%)	70 23%)	21 (7%)	287 (93%)
50-59 (n = 97)	14 (14%)	45 (46%)	16 (16%)	22 (23%)	11 (11%)	86 (89%)
60+ (n = 40)	9 (23%)	14 (35%)	10 (25%)	7 (18%)	4 (10%)	36 (90%)
Total (n = 1160)	153 (13%)	546 (47%)	207 (18%)	254 (22%)	71 (6%)	1091 (94%)

Results showed that 40% of participants reported a reduction in the number of appointments, while only 13% reported no impact on appointment frequency. Among participants using medication, 43% reported a “significant reduction” in appointments, with only 12% observing “no reduction”. Spearman’s rank correlation was computed to assess for a correlation between CrossFit training years and changes to medical appointments, and then number of training sessions per week and changes to medication appointments. CrossFit training years and training frequency did not significantly correlate with whether participants reduced medical appointment or not ($r(1137) = -0.034$, $p = 0.248$, $r(1137) = -0.032$, $p = 0.275$) indicating that training history nor frequency influenced participants perceptions of how CrossFit led to reduced medical appointments. Spearman’s rank correlation was computed to assess for a correlation between age and changes to medical appointments. There was a weak positive correlation between age and reductions to medication usage, $r(1137) = 0.29$, $p = 0.322$.

Seventy-one respondents reported cancelling or postponing surgeries or medical interventions since starting CrossFit (Table 6). The majority of these were aged between 30 and 49 years old. Among them, around one-third reported having been on a waiting list for 18 months or more. Respondents aged 60 and above reported having the shortest wait times, with the majority (67%) reporting being on the list for less than 3 months. Overall, there's considerable variation in waiting times across different age groups, with longer waits observed in the 30-49 age range.

Table 6 Reported effect of CrossFit on Medical Surgeries/interventions reported.

	How long have you been on a waiting list for your surgery/intervention					Participants who reported CrossFit having a positive impact on their surgery*			
Age Group	<3 months	3-12 months	12-18 months	18 months+	Age Group	I am still on the waiting list	Enabled me to function better whilst waiting	My symptoms have been reduced	I no longer need this surgery/ intervention
<19 (n = 0)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	<19 (n = 0)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
20-29 (n = 11)	0 (0%)	7 (64%)	2 (18%)	2 (18%)	20-29 (n = 13)	0 (0%)	2 (15%)	4 (31%)	7 (54%)
30-39 (n = 16)	2 (13%)	5 (31%)	3 (19%)	6 (38%)	30-39 (n = 22)	0 (0%)	2 (9%)	17 (77%)	3 (14%)
40-49 (n = 17)	5 (29%)	4 (24%)	3 (18%)	5 (29%)	40-49 (n = 21)	0 (0%)	3 (14%)	8 (38%)	10 (48%)
50-59 (n = 4)	1 (25%)	1 (25%)	0 (0%)	2 (50%)	50-59 (n = 8)	0 (0%)	1 (13%)	6 (75%)	1 (13%)
60+ (n = 3)	2 (67%)	1 (33%)	0 (0%)	0 (0%)	60+ (n = 3)	0 (0%)	1 (33%)	2 (67%)	0 (0%)
Total (n = 51)	10 (20%)	18 (35%)	8 (15%)	15 (29%)	Total (n = 67)	0 (0%)	9 (13%)	37 (55%)	21 (31%)

*Note the number of respondents varied across questions.

Across all age groups, no participants remained on the waiting list without reporting improvements due to CrossFit. Specifically, 13% reported better functionality while waiting, 55% reported reduced symptoms, and 31% reported no longer needing surgery or intervention. In the 20-29 years age group (n = 11), 64% had been waiting 3-12 months, and 54% no longer required surgery due to CrossFit (Table 6). For those aged 30-39 years (n = 16), 77% reported symptom reduction. In the 40-49 years age group (n = 17), 48% no longer needed surgery. Seventy-five participants aged 50-59 years (n = 4) reported a reduction in symptoms, while in the 60+ years age group (n = 4), 67% reported reduced symptoms. Additionally, a considerable percentage across all age groups (55%) mentioned that CrossFit has enabled them to function better while waiting for surgery, with the highest proportion (54%) observed among respondents aged 20-29. Notably, respondents in the older age categories (50-59 and 60+) also indicated benefits from CrossFit, with the majority reporting symptom reduction or improved functionality (Table 6). Overall, the data indicate that individuals on surgical waiting lists, perceived CrossFit to help them by improving functionality and reducing symptoms, with many ultimately finding they no longer require surgery.

No relationship was found between number of sessions attended per week and reported impact on surgery. However, of those who reported attending at least 2 sessions per week 26 (49%) reported no longer needed surgery, a further 11 (21%) reported that their symptoms had “reduced significantly” since starting CrossFit.

3.4 Qualitative Analysis

Analysis of the comments section yielded a total of 520 raw data extracts. These comments were categorized into two sections: surgery/medical intervention and additional comments.

3.4.1 Surgery/Medical Intervention Comments

Participants who commented on their experiences with surgery and medical interventions reported various outcomes. These included reduced pain, avoidance of surgery, elimination of treatments, and reductions in medication usage. Specifically, 13 participants reported experiencing no pain after engaging in CrossFit, while 14 participants noted feeling physically stronger. Additionally, 27 participants reported avoiding the need for surgery, and 11 participants mentioned eliminating the need for treatments, including reductions in medication use (Figure 2). One participant with young-onset Parkinson’s disease shared, "I have been able to avoid surgery and avoid the need for stronger medications. My disease has also been in remission for longer periods of time. I have reduced my dosage of medication to the lowest dose. My symptoms have improved greatly." Another participant who suffered from chronic pain stated, "I no longer need the strong painkillers I was taking for such a longtime and I also do not now need to see a neurologist or have pain injections." These insights suggest that CrossFit participation was perceived as beneficial in reducing the need for medical interventions.

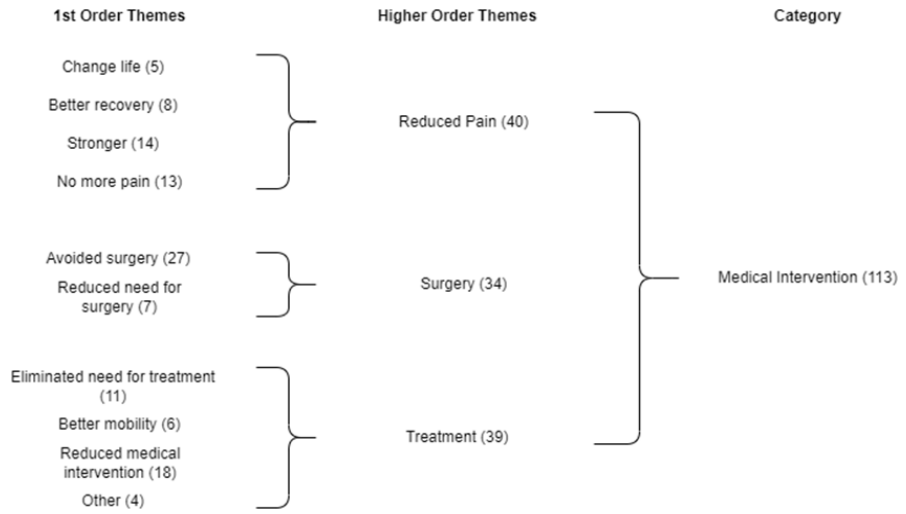

Figure 2 Schematic of the surgery/medical intervention comments categorized into themes (first order themes, higher order themes and category).

3.4.2 Additional Comments

Participants provided additional comments, which fell into three dimensions: physiological (Figure 3), psychological (Figure 4), and social. Many participants highlighted various physiological effects (n = 105), including weight management, improved physical health, symptom alleviation, and medication management. Specifically, 19 participants mentioned weight loss, and 56 participants noted improved physical health. One participant reflected on their experience with pre-diabetes and hypertension: "I was pre-diabetic and on 40 mg/day Lisinopril. Now I'm on 10 mg/day, and my blood sugar is in the normal range." Another commented on their experience with depression and joint pain, stating, "Since starting CrossFit, I have massively reduced pain in both knees, dropped over 10kg in weight, and been able to stop medication for depression."

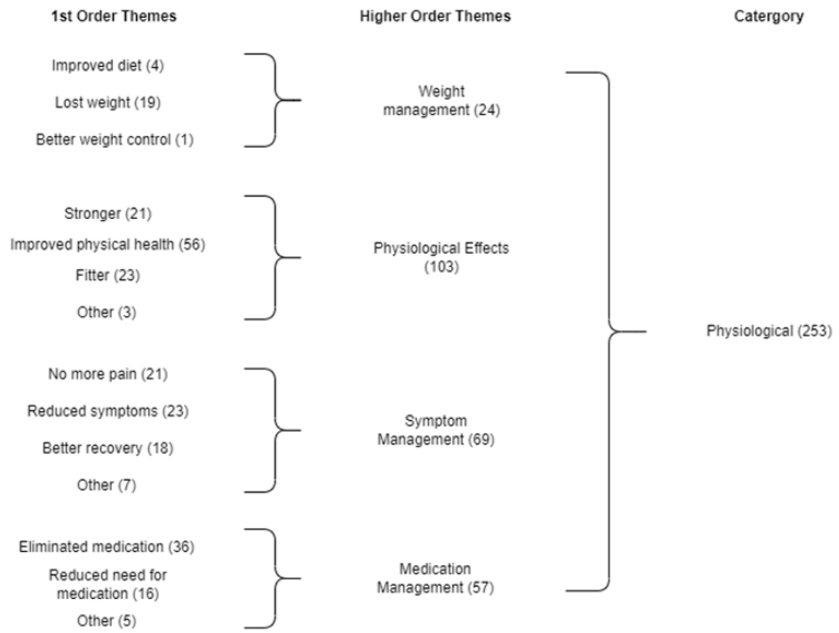

Figure 3 Schematic of the additional comments showing the category of physiological themes (first order themes, higher order themes and category).

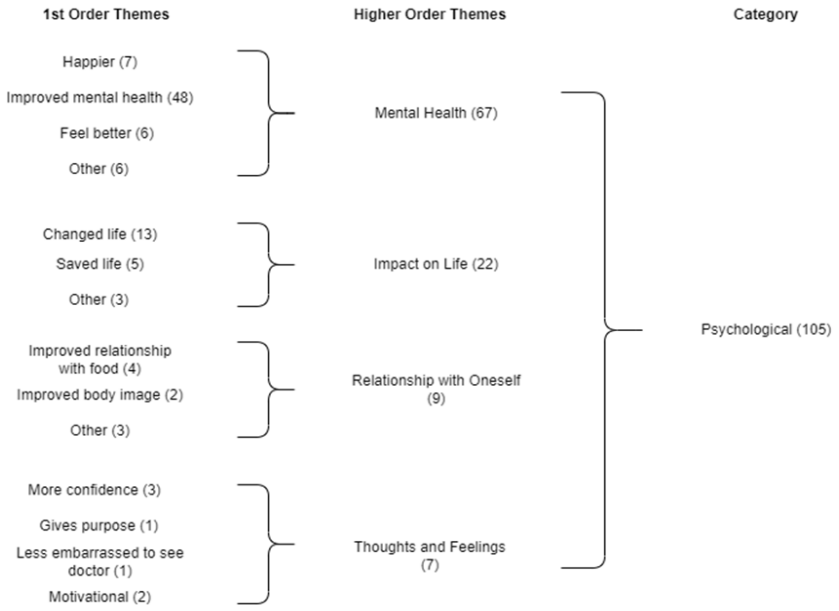

Figure 4 Schematic showing additional comments of the category psychological themes (first order themes, higher order themes and category).

Psychologically, participants emphasized the importance of CrossFit in improving their mental health (Figure 4). One participant described the transformative effect on their mental well-being: *"CrossFit has changed my life. It has saved my mental health. I have so many times been in the darkest place possible, and knowing my community is there has pulled me through."* Another participant shared their experience with postnatal anxiety: *"After I had my son, I had horrendous postnatal anxiety. My gym made so much effort to keep me in classes, even holding the baby whilst I trained. If I had a panic attack mid-workout, they would guide me through my breath and get me back to zero. I owe them my life."* In total, 23 participants reported symptom alleviation related to mental health challenges, including reductions in anxiety and depression.

The social dimension was a recurring theme in the comments, with several participants praising the sense of community fostered by CrossFit. Social aspects were represented by themes of community, coaching, sociability, inclusion, and lifestyle. One participant remarked, *"CrossFit has provided me a community organically, people I now consider family. This sense of community has changed my life for the better."* This communal support was seen as instrumental in maintaining participants' commitment to physical activity and enhancing their overall well-being.

In terms of medication management, 36 participants reported eliminating medication, while 16 participants reported reduced medication usage (Figure 2). One participant with Crohn's disease noted, *"CrossFit is one of the leading reasons why my Crohn's has gone into and remains in remission. My consultant has wholeheartedly encouraged me to continue and is advocating exercise as a way to help prevent flare-ups."* This reinforces the importance of exercise in managing chronic conditions and reducing the reliance on medical interventions.

4. Discussion

The primary objectives of this study were to evaluate the incidence of medical conditions within CrossFit population and to establish the relationship between CrossFit participation and medical intervention. Evidence from this study indicates that 28% of participants across the breadth of age

ranges reported having a pre-existing medical condition prior to starting CrossFit. Of those using medication, 82 participants reported a reduction to medication usage and 69 discontinued medication usage altogether, since starting CrossFit. Importantly, a number of these participants reported a decrease to anti-depressant usage, which may be attributed to social factors associated with CrossFit engagement.

4.1 Medication

The data indicates that 25% of participants with a medical condition reported eliminating their medication usage, while 29% reported reducing it by over half, highlighting a notable trend in reduced medication use among respondents participating in habitual CrossFit training. However, it is important to note that the results do not demonstrate a statistically significant reduction in medication usage.

This reduction can be attributed to the positive impact of physical activity on the body, especially for individuals with chronic diseases. Several determinants, including disease severity, concurrent illnesses, and individual responses to treatment, influence the success of physical activity in managing chronic diseases [24]. Generally, authors such as Williams and Franklin [25] have reported an inverse relationship between medication use and physical activity. However, when compared to other methods, CrossFit's adaptable nature allows training to be customized for each individual through coaching and tailored programs, optimizing physical functioning and potentially reversing restrictions caused by chronic diseases [19, 24]. Furthermore, evidence suggests that CrossFit training can have a positive effect on body composition, aerobic and anaerobic capacity, and cardiovascular health [26, 27]. Although a weak positive correlation was observed between the number of CrossFit training years, the amount of weekly training, and medication reduction, these correlations were not statistically significant. Therefore, caution should be taken when interpreting these findings. The data suggest that even individuals with less than a year of CrossFit training experience or those training once a week may experience some level of benefit. However, the specific nature and extent of these benefits were not clearly defined in this study. Additionally, the majority of participants had been on medication for less than 10 years, with only 6% reporting long-term medication use. This indicates that the study's results may not be fully applicable to older individuals or those who have been on medication for an extended period. Further research is needed to explore these factors in more diverse populations and to more precisely identify and quantify the potential health benefits associated with varying levels of CrossFit participation.

4.1.1 Implications for Medication Cost and Healthcare Services

A number of participants attributed a reduction in medication usage to CrossFit participation. While the study did not specifically measure medication costs, it is plausible that reduced medication use could lead to lower associated costs. The most commonly reported medications in the study were antidepressants, painkillers, and inhalers for asthma. While the study did not provide data on medication costs, it is possible that reducing or eliminating these medications could lead to significant cost savings.

Exercise, including CrossFit, is known to improve mental health [28], and the social support inherent in CrossFit may contribute to psychological wellbeing and adherence [29]. Additionally, chronic pain often leads to dependence on painkillers [30], and the diverse exercise modalities in

CrossFit might improve joint health and movement quality, potentially reducing pain [31]. For instance, Fisker et al. [32] found that increased tendon thickness following CrossFit training could enhance joint strength and mobility, which might contribute to decreased pain and reduced need for painkillers.

Asthma was the third most reported condition in the study. Research has shown that medication adherence can be problematic for asthma patients [33]. CrossFit has been associated with improved cardiovascular fitness and lung function [34], which could help manage asthma symptoms. While the study observed that participants often engaged in CrossFit 3-4 times per week or more, this high level of participation might exceed typical recommendations for physical activity. This increased engagement may be due to the high level of social support and the diverse physical activities offered in CrossFit, potentially making it more effective in maintaining activity levels despite health challenges.

Although the study suggests that CrossFit participation might reduce medication use, it did not provide specific data on medication cost reductions. Future research should include detailed cost analyses to better understand the potential economic benefits of exercise programs for individuals with chronic conditions.

4.1.2 Age

As expected, a higher proportion of older age groups were on medication compared to younger age groups. For example, in the 60+ age group, 48% of participants reported medication usage prior to starting their fitness journey. Of this group, the largest proportion of participants (26%) had reportedly been on medication for 11-20 years and therefore, health issues were not likely to be short-term. In younger age groups (e.g., 20-29 years and 30-29 years), respondents were more likely to report medication usage for 3-6 years. The 20-39 years respondents also reported reducing or eliminating medication usage, which is a novel finding. The participants self-reported changes to medication usage suggest that there may be age-related differences in health status, medication management practices, and possibly in how individuals respond to CrossFit training. It is important to further investigate the underlying factors contributing to these differences in medication usage. Such research could provide deeper insights into how age influences medication management and the potential benefits of CrossFit for various age groups.

Previous studies have investigated the relationship between physical activity and reduced medication usage, but these appear to be in older age groups (see example: Silva et al., [35] 2012 and Ribeiro et al., [36]). This reduction to medication usage is likely indicative of improved health, which according to data presented in the current study, is particularly important to the older age groups who may otherwise demonstrate decreased quality of life and physical wellbeing.

Age groups consistently reported a training schedule of 3-4 sessions per week, with the exception of the <19 age group, which reported participation rates of 5+ sessions per week. Although the study cannot establish a dose-response relationship due to its cross-sectional design, the data suggest that engaging in CrossFit 3-4 times per week may be associated with perceived effects on medication usage. This frequency of training is lower than the previously recommended 5-6 hours per week [37], indicating that even moderate levels of CrossFit participation might be beneficial.

4.2 Medical Intervention

Another significant finding of this study is the reduction in GP (doctors) appointments which participants attributed to regular CrossFit participation. Participants reported a 40% reduction in appointments, with only 13% experiencing no effect on appointment frequency. Among participants using medication, there was a 61% decrease in appointments, with only 12% reporting no reduction. This indicates that those with long term disease, injury or illness may have perceived increased benefit from engaging in regular CrossFit. Although the correlation between training years and the reduction in medical appointments was not statistically significant, like other studies (see Gine-Garriga et al. [38]), the observed positive trend suggests that both short- and long-term participation in CrossFit may contribute to a reduced need for medical appointments, indicating potential health benefits over time.

An interesting observation from the study was that 71 participants reported cancelling or postponing a surgical or medical intervention, which they attributed to their participation in CrossFit. While this finding is self-reported and should be interpreted with caution, it highlights a potential trend that warrants further investigation. Previous research suggests that regular weekly exercise, amounting to 5-6 hours per week, can help individuals reduce the need for medical interventions [37]. In our study, 55% of participants reported training 3-4 times per week, and 35% trained 5+ times per week. Despite engaging in fewer sessions per week than the recommended 5-6 hours [37] participants felt this level of activity may have contributed to their ability to delay or cancel a scheduled intervention. It is important to note that the weak correlations observed in training years (-0.02) and training sessions per week (0.11) do not establish a causal relationship, and further research is needed to explore whether different training durations may be associated with a reduced need for medical interventions.

Regular physical activity is widely recognized for its role in preventing chronic diseases and lowering the risk of premature death [37]. Although our study cannot establish causality, the data suggest that individuals participating in CrossFit may perceive themselves as becoming stronger and physically healthier through regular training. This could potentially contribute to a reduced need for medical interventions, such as appointments or medications. However, it is important to note that the observed associations do not indicate a linear relationship between physical activity, medication use, and GP appointments. Additionally, while these findings are specific to our study population, further research is needed to determine how applicable they are to the broader general public.

4.2.1 Surgery/Medical Treatment Comments

Additional' comments on surgeries and medical treatments revealed that participants felt CrossFit helped them avoid surgery, improve their recovery, and reduce the need for treatment. Improved strength, mobility, and recovery are essential for individuals with chronic diseases [39]. Exercise interventions that focus on strength, range of motion, and aerobic conditioning have been shown to reduce symptoms and the need for treatment [31]. For example, a study by Bergland et al. [40] found that exercise interventions improved the quality of life in elderly women by enhancing mobility. Similarly, a 6-month home-based exercise intervention for elderly women with vertebral fractures resulted in reduced pain and improved strength, contributing to better recovery [40]. By addressing these key factors, exercise, and specifically CrossFit, can reduce the need for surgeries and medical treatments.

4.3 Additional Comments

Participants' additional comments provided insights into three dimensions: physiological, psychological, and social.

4.3.1 Physiological Comments

Participants reported significant improvements in their physical health, which aligns with the nature of CrossFit training. Heinrich et al. [41] found chronic improvements in lean mass, fat mass, and body fat percentage within five weeks of CrossFit training in cancer survivors. Weight management is crucial for treating obesity and managing other chronic diseases like diabetes and cardiovascular conditions [42]. The 103 statements related to improved physiological effects suggest that CrossFit has a positive impact on physical health. Gine-Garriga et al. [38] also support this, as improved physiological health can lead to reduced symptoms, medication use, and the total elimination of medication, ultimately improving symptom and medication management for individuals.

4.3.2 Psychological Comments

Psychological improvements were significant within this study, with 67 statements mentioning improved mental health and 22 statements highlighting the impact of CrossFit on participants' lives. Heinrich et al. [41] reported improvements in emotional functioning in addition to physiological effects. Fisher et al. [29] found that motivation for CrossFit participation improved, similar to that seen in traditional sports. These psychological benefits contribute to long-term adherence, as supported by the 94% adherence rate observed by Eather et al. [43]. Higher adherence rates lead to improved mental and physical health, reducing medication use, particularly for antidepressants.

4.3.3 Social Comments

The strong sense of community within CrossFit was evident, with 24 comments mentioning the importance of the social aspect. This community is welcoming and inclusive, making it easier for newcomers to adapt to the culture, especially with coaching support and competitions available. This community fosters friendships and relationships [44] and improves adherence [45]. The greater sense of belonging within CrossFit compared to traditional gyms [45] can further enhance adherence rates, promoting better mental and physical health and ultimately reducing medication use among individuals with chronic diseases.

4.4 Limitations

We acknowledge that the external validity of the study may be limited due to volunteer bias resulting from sample recruitment and the self-reporting nature of the study design. We also recognize that participants who engaged with the study were those predominantly involved in CrossFit and were a self-motivated sample. Recruiting those from outside of CrossFit would likely have detracted from key study aims, though would have provided a different perspective. Additionally, the absence of gender-specific data reported in this study poses a limitation to its generalizability. In addition, it is also important to note that not all respondents provided sufficient

detail about medication usage, therefore incomplete data sets were excluded from the analysis to avoid potential bias. This is an evident limitation of using a self-reported survey. Despite several limitations, the study incurs several strengths that add to the innovation of the study results. Quantitative and qualitative data were collected to obtain a more extensive evaluation, providing greater insight into participants' perceptions of medical intervention and participation in CrossFit. To our knowledge, this study is the only research to investigate perceptions of CrossFit participation and self-reported medical usage; therefore, results are innovative and further evidence the need for greater research into the use of functional fitness to support long-term health in the general, non-athletic population. The study serves as a preliminary piece that will further enhance investigative work in this field. Moreover, the study provides insights into how self-reported surveys may be used by other stakeholders to evaluate their own services and interventions.

4.5 Future Research

To establish causality, prospective studies and longitudinal designs are necessary. Given the limited research on the impact of CrossFit on medical intervention reduction, future research should aim to replicate this study with larger and more diverse participant cohorts, including individuals with varied medication use and exercise habits. Such studies could provide a clearer understanding of how different chronic diseases and medications are affected by CrossFit participation, thereby informing healthcare professionals about the potential benefits of prescribing exercise as a treatment. Additionally, this research could assist CrossFit coaches in offering more targeted support to individuals with various conditions. Investigating the effects of CrossFit across different age groups, and exploring whether starting CrossFit at a younger age has a more pronounced impact on reducing medical interventions, would also be a valuable focus for future studies.

Moreover, future studies should incorporate more detailed questions to gather information on the type and quantity of medication used. This would provide a more accurate assessment of cost-effectiveness, and the economic burden associated with chronic diseases. Considering the potential effects of inflation and rising living costs, updated medication price data should be utilized to estimate cost reductions accurately.

5. Conclusions

In summary, the results of this study suggest that CrossFit training may be associated with a reduced need for medical interventions, potentially alleviating some of the economic burden of chronic diseases on the NHS. While our findings do not demonstrate causality, they indicate a possible link between CrossFit participation and lower medication usage, fewer GP appointments, and a reduced need for surgeries and medical treatments. This could contribute to easing the strain on hospital resources caused by the growing burden of chronic diseases in an ageing population. Although the sense of community within CrossFit is often highlighted as a factor promoting adherence, this study did not collect specific data on adherence rates. Nevertheless, regular exercise is widely recognized for its role in delaying the onset of chronic diseases and reducing their severity. The improvements in both mental and physical health observed in this study may contribute to a reduced need for medication.

Future research should aim to replicate this study with larger and more diverse participant cohorts, considering different age groups and incorporating more detailed questions about

medication usage and health outcomes. By expanding our understanding of CrossFit's potential effects on medical intervention reduction, we can provide better insights for healthcare professionals and coaches, ultimately supporting individuals with chronic diseases.

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Author Contributions

Conceptualization, Athalie Redwood-Mills and Taea Scott; Data curation, Athalie Redwood-Mills and Taea Scott; Formal analysis, Athalie Redwood-Mills, Jennifer Wilson and Taea Scott; Investigation, Athalie Redwood-Mills and Taea Scott; Methodology, Athalie Redwood-Mills and Taea Scott; Project administration, Athalie Redwood-Mills; Resources, Athalie Redwood-Mills; Software, Athalie Redwood-Mills; Supervision, Athalie Redwood-Mills; Validation, Athalie Redwood-Mills, Jennifer Wilson and Mhairi Morris; Visualization, Athalie Redwood-Mills, Jennifer Wilson and Mhairi Morris; Writing - original draft, Athalie Redwood-Mills and Taea Scott; Writing - review & editing, Jennifer Wilson and Mhairi Morris.

Competing Interests

The authors declare no conflict of interest. CrossFit UK had no role in the analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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