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Original Research Article

Effect of swimming on the happiness levels of young adults: a pilot study

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ABSTRACT

Background: Happiness is an important component of subjective wellbeing among young adults. Swimming may influence happiness through aerobic activity, rhythmic breathing and water immersion. This pilot study assessed happiness levels among swimmers and compared them with non-swimmers using the Oxford Happiness Questionnaire (OHQ) and salivary serotonin.
Methods: This non-randomised interventional pilot study was conducted over one year among apparently healthy young adults aged 18-26 yr. Forty participants were included, with 20 swimmers and 20 non-swimmers. The swimmer group underwent a structured six-week swimming programme, three sessions per week, with each session lasting approximately 50 min. OHQ scores and salivary serotonin levels were assessed at baseline, after six weeks and at six-month follow-up. Data were analysed using appropriate parametric and non-parametric tests.
Results: The two groups were comparable at baseline. Baseline OHQ scores did not differ significantly between swimmers and non-swimmers (4.128±0.412 vs. 3.879±0.576; p=0.125). At six weeks, swimmers had significantly higher OHQ scores than non-swimmers (4.412±0.385 vs. 3.805±0.492; p<0.001), and this difference persisted at six months (4.288±0.418 vs. 3.895±0.496; p=0.010). Salivary serotonin increased significantly among swimmers [14.36 (7.65-23.32) ng/mL; p<0.001] and declined among non-swimmers [-10.50 (-20.69 to -1.08) ng/mL; p=0.002]. Overall correlation between serotonin change and OHQ score was mild but significant (r=0.427; p=0.006).
Conclusions: Structured swimming was associated with improved happiness levels among young adults. Larger randomised studies are needed to confirm these preliminary findings.

Keywords: Happiness, Oxford Happiness Questionnaire, Salivary serotonin, Swimming, Young adults

INTRODUCTION

Mental wellbeing has become an important public health concern among young adults, particularly during the transition from adolescence to independent adulthood. This period is associated with academic pressure, identity development, changing social roles and lifestyle changes, which may influence emotional health and happiness. Recent global evidence suggests that the earlier pattern of relatively better wellbeing in youth has changed, with young people now showing marked deterioration in mental health and subjective wellbeing.[1] The World Health Organization also reports that one in seven adolescents experiences a mental disorder, indicating that emotional health concerns often begin before or during early adulthood.[2]

College-going and young adult populations are especially vulnerable because this phase combines educational stress, career uncertainty, social comparison and changing sleep and activity patterns. In a study among college students, symptoms of depression, anxiety and stress were reported in a considerable proportion of participants, showing that psychological distress is common in this age group.[3] India

also continues to show low positioning in global happiness rankings, with the World Happiness Report placing India low among participating countries in recent years, including 118th rank in 2025.[4] These findings highlight the need for simple, acceptable and low-cost strategies to improve happiness and psychological wellbeing among young adults.

Happiness is generally understood within the broader framework of subjective wellbeing, which includes emotional experiences, life satisfaction and cognitive evaluation of one's life.[5] However, psychological wellbeing is not limited to pleasure or positive mood alone; it also includes purpose, personal growth, autonomy and effective functioning.[6] Recent work also shows overlap between happiness, wellbeing and quality of life, suggesting that happiness is a multidimensional construct rather than a single emotional state.[7] From a public health perspective, subjective wellbeing is important because it reflects how individuals experience their lives and can influence health behaviour, productivity and social functioning.[8]

Physical activity has received increasing attention as a practical approach to support mental wellbeing. Evidence from systematic reviews indicates that physical activity interventions can reduce symptoms of depression, anxiety and psychological distress across different adult populations.[9] A recent network meta-analysis also reported that exercise is effective for depression, supporting its role as a non-pharmacological strategy for mental health promotion.[10] Among college students, physical activity intensity has been positively associated with subjective wellbeing, suggesting that exercise may contribute not only to symptom reduction but also to positive psychological states.[11]

For the assessment of happiness, the Oxford Happiness Questionnaire is a widely used instrument that measures happiness as a broad psychological construct. It was developed as a compact scale for assessing psychological wellbeing and includes items related to positive affect, satisfaction, optimism and social functioning.[12] Further psychometric evaluation using Rasch analysis has supported refinement of the scale and improved its measurement properties.[13] Therefore, the Oxford Happiness Questionnaire provides a suitable tool for assessing happiness levels in young adults.

Serotonin, or 5-hydroxytryptamine, is an important monoamine neurotransmitter involved in mood, behaviour and several physiological functions.[14] The serotonergic system has widespread effects on mood, anxiety, stress regulation, sleep and cognition.[15] Although serotonin should not be understood simply as a "happiness chemical", it remains an important component of emotional regulation and psychological adaptability. Lifestyle factors, including exercise, may influence serotonergic activity through changes in tryptophan availability, neuronal activity and related neurobiological pathways.[16]

Swimming is a distinct form of aerobic physical activity because it combines whole-body exercise with water immersion, rhythmic breathing and low-impact movement. Aquatic exercise has shown favourable effects on mental health outcomes, including mood, anxiety, depression and wellbeing.[17] A systematic review and meta-analysis also found that aquatic exercise can significantly improve mood and anxiety symptoms.[18] More recent longitudinal evidence among college students suggests that structured swimming intervention may improve emotional wellbeing, social adaptation and academic stress management.[19]

Along with psychological assessment, biological markers may help explore possible mechanisms underlying the relationship between swimming and happiness. Salivary serotonin offers a non-invasive method for examining peripheral serotonergic changes and has been studied in relation to mood and cardio-autonomic function.[20] However, evidence regarding swimming, happiness and salivary serotonin in young adults remains limited. Hence, this pilot study was planned to assess whether young adults who perform swimming differ in happiness level from non-swimmers, using both the Oxford Happiness Questionnaire and salivary serotonin.

Therefore, this pilot study was planned to assess the happiness level of swimmers and compare happiness levels between swimmers and non-swimmers using the Oxford Happiness Questionnaire and salivary serotonin. The study also aimed to compare happiness levels between male and female subjects and determine the correlation between Oxford Happiness Questionnaire scores and salivary serotonin.

METHODS

This non-randomised interventional pilot study was conducted over a period of one year from November, 2024 to October, 2025 in the Department of Physiology in collaboration with the Department of Pathology, King George's Medical University, Lucknow. Apparently healthy young adults aged 18-26 yr were recruited from medical and dental student populations. Participants were enrolled after detailed history taking and clinical screening. Written informed consent was obtained from all participants before inclusion in the study.

A total of 40 participants were included, with 20 participants in the swimmer group and 20 in the non-swimmer group. The sample size was selected pragmatically for this pilot study to assess feasibility, participant compliance and preliminary trends, and to generate baseline data for planning larger studies. Participants were allocated into groups according to predefined eligibility criteria. Individuals who were able to swim and had not participated in structured physical

activity such as yoga, gym, running or sports during the preceding six months were included in the swimmer group. Sedentary individuals who were not planning any lifestyle modification during the study period were included in the non-swimmer group.

Young adults aged 18-26 yr with normal or overweight body mass index (BMI), no comorbid illness and willingness to participate were included. Participants with obesity, chronic systemic disease, acute illness, recent hospitalisation for more than 24 h, major surgical procedure, inability to swim for swimmer group, or refusal to provide consent were excluded.

At baseline, anthropometric parameters including height, weight and BMI were recorded. Vital parameters were noted. Happiness level was assessed using the Oxford Happiness Questionnaire (OHQ), and saliva samples were collected for serotonin estimation. The OHQ is a 29-item self-report questionnaire scored on a six-point Likert scale. Reverse scoring was applied for negatively framed items, and the final happiness score was calculated by averaging the item scores.

Participants in the swimmer group underwent a structured swimming programme for six weeks. The programme consisted of three sessions per week, with each session lasting approximately 50 min. Each session included warm-up, main swimming activity and cool-down. The protocol was gradually progressed over time with freestyle swimming, kicking and cool-down phases. The non-swimmer group continued their routine sedentary lifestyle during the study period. Post-intervention assessment of OHQ score and salivary serotonin was performed after six weeks. Follow-up assessment was performed after completion of the intervention.

Fasting saliva samples were collected at 8 a.m. to minimise diurnal variation. Salivary flow was facilitated by mechanical stimulation of the cheeks for one minute. Unstimulated whole saliva was collected by the drooling method into sterile collection vials. Spitting was avoided to reduce contamination and aeration of the sample. Samples were centrifuged immediately to remove cellular debris, and the clear supernatant was separated and stored at -40°C until biochemical analysis. Before assay, samples were brought to room temperature and processed without additional dilution.

Salivary serotonin was estimated using a competitive enzyme-linked immunosorbent assay (ELISA). Standards and saliva samples were analysed in duplicate according to the manufacturer's protocol. In brief, 50 µl of standard or sample was added to the designated wells, followed by 50 µl of biotinylated detection antibody working solution. The plate was incubated at 37°C for 45 min and washed three times. Subsequently, 100 µl of HRP conjugate working solution was added, followed by incubation at 37°C for 30 min. After five washes, 90 µl of substrate reagent was added and the plate was incubated in the dark at 37°C for approximately 15 min. The reaction was stopped using 50 µl of stop solution. Optical density was measured immediately at 450 nm using a microplate reader. A standard calibration curve was prepared, and serotonin concentration was calculated by interpolation from the curve. The mean of duplicate readings was used for statistical analysis.

The study protocol was approved by the Institutional Ethics Committee of King George's Medical University, Lucknow. The study was conducted in accordance with institutional ethical standards. Participation was voluntary, confidentiality was maintained and participants were free to withdraw from the study at any stage without academic or medical consequence.

Data were compiled using Microsoft Excel and analysed using SPSS version 21.0. Normality of data was assessed before inferential analysis. Categorical variables were expressed as numbers and percentages, and continuous variables as mean±standard deviation. Chi-square test was used for comparison of categorical variables. Student's t test was used to compare mean values between two groups, and paired t test was used for within-group comparison across two time points. Mann-Whitney U test and Wilcoxon signed-rank test were used for non-parametric data where applicable. Pearson's correlation test was used to assess the strength and direction of linear association between OHQ score and salivary serotonin. A p value <0.05 was considered statistically significant.

RESULTS

A total of 40 young adults were included in the study, with 20 participants in the swimmer group and 20 in the non-swimmer group. The mean age of the study population was 19.70±1.22 yr, with an age range of 18-22 yr. The mean age was 20.00±1.30 yr among swimmers and 19.40±1.10 yr among non-swimmers. Overall, 25 participants (62.5%) were male and 15 (37.5%) were female. The two groups were comparable with respect to baseline demographic and lifestyle characteristics. Normal BMI was observed in 17 (85.0%) swimmers and 16 (80.0%) non-swimmers, while 3 (15.0%) swimmers and 4 (20.0%) non-swimmers were overweight. The mean BMI was 22.58±2.05 kg/m² in swimmers and 22.73±2.33 kg/m² in non-swimmers (p=0.826). Dietary pattern was also comparable between groups, with 11 (55.0%) swimmers and 12 (60.0%) non-swimmers being vegetarian (Table 1).

At baseline, the mean Oxford Happiness Questionnaire (OHQ) score was higher among swimmers than non-swimmers, but the difference was not statistically significant (4.128±0.412 vs. 3.879±0.576; p=0.125). At six weeks, swimmers showed significantly higher OHQ scores compared with non-swimmers (4.412±0.385 vs. 3.805±0.492; p<0.001). At six months, the OHQ score remained significantly higher among swimmers than non-swimmers (4.288±0.418 vs. 3.895±0.496; p=0.010) (Table 2, Figure 1).

Table 1: Baseline characteristics of the study participants.

Characteristics	Swimmer (n=20)	Non-swimmer (n=20)	Total (n=40)	Test statistic/p value
Age, years, mean±SD	20.00±1.30	19.40±1.10	19.70±1.22	
Age range, years	18-22	18-22	18-22	
Male, N (%)	12 (60.0)	13 (65.0)	25 (62.5)	
Female, N (%)	8 (40.0)	7 (35.0)	15 (37.5)	
Normal BMI, N (%)	17 (85.0)	16 (80.0)	33 (82.5)	χ^2=0.173; p=0.677
Overweight, N (%)	3 (15.0)	4 (20.0)	7 (17.5)	Fisher exact p=1.000
BMI, kg/m², mean±SD	22.58±2.05	22.73±2.33	22.65±2.17	t=-0.221; p=0.826
BMI range, kg/m²	19.50-25.80	19.80-27.80	19.50-27.80	
Vegetarian, N (%)	11 (55.0)	12 (60.0)	23 (57.5)	χ^2=0.102; p=0.749
Non-vegetarian, N (%)	9 (45.0)	8 (40.0)	17 (42.5)	Fisher exact p=1.000

Table 2: Comparison of Oxford happiness questionnaire scores between swimmers and non-swimmers.

Time interval	Swimmer (n=20), mean±SD	Non-swimmer (n=20), mean±SD	t value	P value
Baseline	4.128±0.412	3.879±0.576	1.569	0.125
6 weeks	4.412±0.385	3.805±0.492	4.346	<0.001
6 months	4.288±0.418	3.895±0.496	2.709	0.010

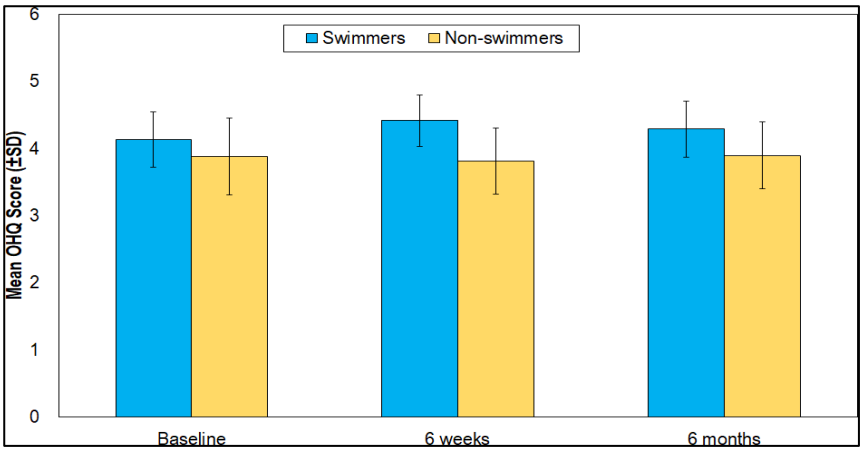


Figure 1: Comparison of Oxford happiness questionnaire scores between swimmers and non-swimmers at baseline, 6 weeks and 6 months

Table 3: Intragroup change in Oxford Happiness Questionnaire score

Group	Time interval	Mean change	SD	Change (%)	t value	P value
Swimmer	6 weeks	0.271	0.288	6.56	4.198	<0.001
	6 months	0.160	0.305	3.88	2.351	0.030
Non-swimmer	6 weeks	-0.074	0.150	-1.91	-2.207	0.040
	6 months	0.016	0.176	0.40	0.394	0.698

Table 4: Salivary serotonin levels and correlation with Oxford happiness questionnaire score.

Parameters	Swimmer	Non-swimmer	Test statistic	P value
Baseline salivary serotonin, ng/ml, median (IQR)	22.00 (13.11-52.31)	29.06 (15.41-73.20)	Z=0.893	0.372
6-week salivary serotonin, ng/ml, median (IQR)	37.98 (25.29-73.57)	19.48 (9.88-44.49)	Z=1.921	0.055

Continued.

Parameters	Swimmer	Non-swimmer	Test statistic	P value
Change in salivary serotonin, median (IQR)	14.36 (7.65-23.32)	-10.50 (-20.69 to -1.08)	Swimmer Z=3.920; Non-swimmer Z=-3.174	<0.001; 0.002
Change (%)	65.27	-36.13		
Correlation between change in salivary serotonin and OHQ score at 6 weeks	r=0.114	r=-0.068	Pearson correlation	0.633; 0.777
Overall correlation, total population	r=0.427		Pearson correlation	0.006

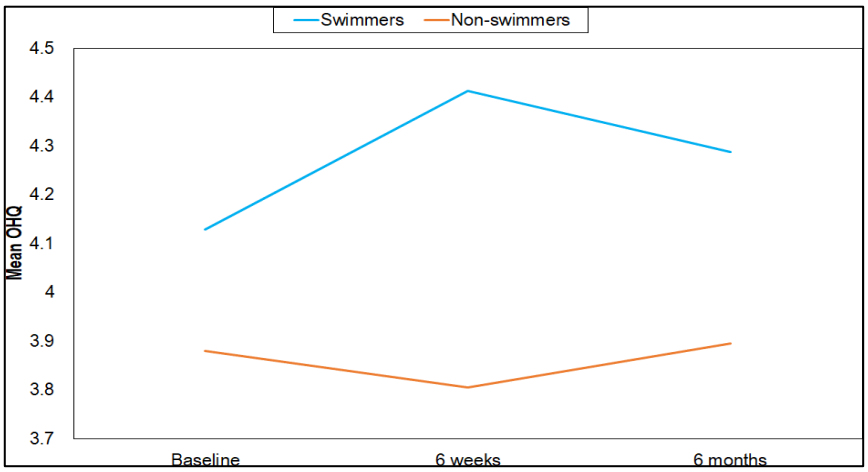


Figure 2: Intragroup change in baseline Oxford happiness questionnaire score at 6 weeks and 6 months.

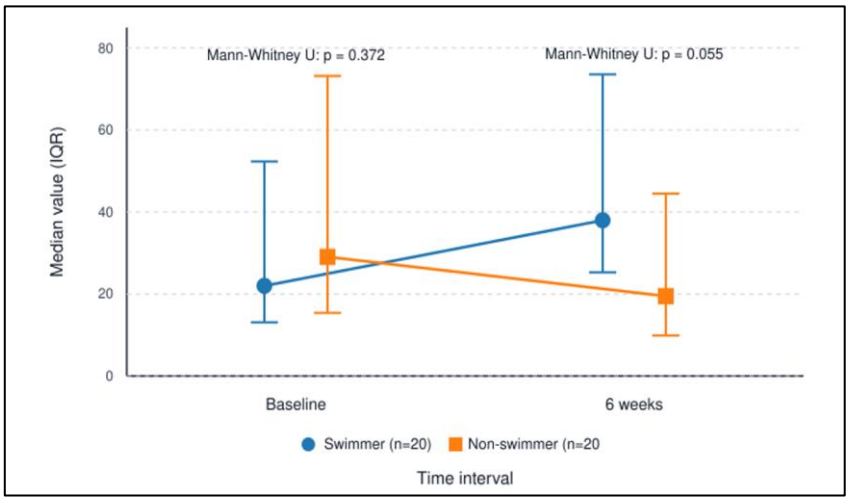


Figure 3: Comparison of salivary serotonin levels between swimmers and non-swimmers at baseline and 6 weeks.

On intragroup analysis, swimmers showed a significant increase in OHQ score from baseline at six weeks, with a mean change of 0.271±0.288, corresponding to a 6.56 per cent increase (p<0.001). At six months, the increase from baseline remained significant, with a mean change of 0.160±0.305 and 3.88 per cent change (p=0.030). Among non-swimmers, OHQ score showed a significant decline at six weeks, with a mean change of -0.074±0.150 and -1.91 per cent change (p=0.040). At six months, the change among non-swimmers was small and not statistically significant (0.016±0.176; p=0.698) (Table 3, Figure 2).

Baseline salivary serotonin levels did not differ significantly between swimmers and non-swimmers [22.00 (13.11-52.31) vs. 29.06 (15.41-73.20) ng/mL; p=0.372]. At six weeks, salivary serotonin was higher among swimmers than non-swimmers [37.98 (25.29-73.57) vs. 19.48 (9.88-44.49) ng/mL], although the between-group difference did not reach statistical significance (p=0.055) (Table 4, Figure 3).

Within-group analysis showed a significant increase in salivary serotonin among swimmers at six weeks, with a

median change of 14.36 (7.65-23.32) ng/mL, corresponding to a 65.27 per cent increase ($p<0.001$). In contrast, non-swimmers showed a significant decline in salivary serotonin, with a median change of -10.50 (-20.69 to -1.08) ng/mL and -36.13 per cent change ($p=0.002$) (Table 4, Figure 4).

Correlation analysis at six weeks showed a poor and non-significant correlation between change in salivary serotonin and OHQ score among swimmers ($r=0.114$; $p=0.633$) and non-swimmers ($r=-0.068$; $p=0.777$). However, in the total study population, the correlation was mild and statistically significant ($r=0.427$; $p=0.006$) (Table 4).

DISCUSSION

The present pilot study assessed the influence of structured swimming on happiness levels among young adults using the Oxford Happiness Questionnaire and salivary serotonin. The swimmer and non-swimmer groups were comparable at baseline for age, sex distribution, body mass index and dietary pattern, reducing the likelihood that baseline demographic differences explained the observed findings. The baseline OHQ score did not differ significantly between the two groups. After six weeks, swimmers had significantly higher OHQ scores than non-swimmers, and this difference was also present at six months. Within-group analysis further showed a significant increase in OHQ score among swimmers after six weeks, with partial persistence of improvement at six months. These findings suggested that structured swimming was associated with improvement in happiness level among young adults.

The biochemical findings showed a similar favourable direction within the swimmer group. Although the between-group difference in salivary serotonin at six weeks did not reach statistical significance, swimmers showed a significant rise from baseline, whereas non-swimmers showed a significant decline. The overall correlation between change in salivary serotonin and OHQ score was mild but statistically significant, while group-wise correlations were poor and non-significant. This indicated that salivary serotonin may have reflected some biological change associated with swimming, but happiness could not be explained by serotonin alone.

The findings were broadly consistent with previous evidence supporting the role of physical activity in mental wellbeing. Physical activity interventions have been reported to improve depression, anxiety and psychological distress across adult populations, and exercise has also been shown to be effective for depression in a systematic review and network meta-analysis.[9,10] Although these studies mainly assessed psychological distress rather than happiness, their findings supported the same favourable direction observed in the present study. The present study differed by focusing on happiness as a positive psychological outcome instead of only reduction of distress.

The results were also consistent with evidence from young and student populations. A positive relationship between physical activity intensity and subjective wellbeing has been reported among college students.[11] In the present study, swimmers showed higher OHQ scores after the intervention compared with non-swimmers. This supports the possibility that regular physical activity, when performed in a structured and enjoyable form such as swimming, may contribute to better subjective wellbeing among young adults.

Swimming may offer additional benefits beyond general exercise. It combines aerobic activity, rhythmic breathing, whole-body movement and water immersion. Aquatic exercise has been reported to have favourable effects on mental health outcomes, and meta-analytic evidence has shown improvement in mood and anxiety symptoms with aquatic exercise.[17,18] A swimming-based intervention among college students also reported improvement in emotional wellbeing, social adaptation and academic stress management.[19] These findings were comparable with the present study, where structured swimming was associated with improved OHQ scores.

The improvement in OHQ score among swimmers may have resulted from multiple mechanisms. Swimming involves regular physical exertion, controlled breathing and repeated engagement in a structured routine. These factors may reduce stress arousal and improve emotional regulation. Water immersion may also provide relaxation and sensory comfort, which could support better mood. In addition, participation in a scheduled activity may improve discipline, self-efficacy and social interaction, all of which can influence happiness in young adults.

The serotonin findings require careful interpretation. Serotonin is involved in mood regulation, behavioural functions and stress-related responses.[14,15] Physical activity may influence serotonin-related mechanisms, but salivary serotonin remains a peripheral measure and may not directly represent brain serotonin activity.[16] Salivary serotonin has been studied as a non-invasive marker in relation to mood and cardio-autonomic function.[20] In the present study, the rise in salivary serotonin among swimmers was in a favourable direction, but the lack of significant between-group difference suggested that this finding should be considered preliminary.

Happiness is a multidimensional construct. Subjective wellbeing includes positive affect, life satisfaction and cognitive evaluation of life.[5] Psychological wellbeing also includes meaning, personal growth and optimal functioning.[6] Therefore, the improvement in happiness after swimming was unlikely to be due to a single biochemical pathway. It may have reflected the combined influence of physical activity, relaxation, routine, social engagement, perceived fitness and aquatic experience.

Limitations

The present study had certain limitations. Being a pilot study, the sample size was small and the study followed a non-randomised design. Participants were recruited from the student population of a single institution, which may limit the generalisability of the findings. Potential influencing factors such as sleep pattern, academic stress, social support, dietary variation, examination schedule and personality traits were not extensively controlled. In addition, salivary serotonin was used as a peripheral biomarker and cannot be considered a direct measure of central serotonergic activity. Therefore, the biochemical findings should be interpreted cautiously and require confirmation in larger, randomised studies.

CONCLUSION

Structured swimming was associated with improvement in happiness among young adults, as demonstrated by significantly higher Oxford Happiness Questionnaire scores among swimmers after six weeks, with the difference persisting at six months. Salivary serotonin also increased significantly from baseline among swimmers, although the between-group difference at six weeks did not reach statistical significance. A mild significant correlation between change in salivary serotonin and happiness score was observed in the overall study population. These findings suggest that regular structured swimming may have a favourable role in promoting psychological wellbeing among young adults; however, larger randomised studies are required to confirm these findings and clarify the underlying biological mechanisms.

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