Precipitation anomaly in rainy season based on high resolution SAR and regulation of blood glucose in aerobic exercise for adolescents

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Abstract
This paper contains a large number of radar data information, analyzes the radar scattering characteristics of water masses in different imaging areas, such as quiet open area, wave area, agricultural area, and compares with the application of high-resolution SAR image extraction algorithm. We also use the data analysis of the data center to explore the evolution characteristics of the high-level and low-level atmospheric circulation and water vapor transport field before and after the beginning and end of the rainy season precipitation anomaly in Southwest China. Then, the low-frequency evolution characteristics of the precipitation anomaly series in the rainy season in Southwest China are analyzed, and eight phases are divided according to the 20–60 day intraseasonal oscillation of precipitation, which provides convenience for the transportation of low-frequency water and air. Thirdly, the method is applied to aerobic exercise. However, people with low blood glucose regulation are generally overweight, and drug treatment itself cannot change their health. Exercise has always been the most effective way of muscle strength training. If aerobic exercise and resistance exercise are combined, it can be combined exercise training. If the sequence and duration are long enough, excess sugar in the body can be burned. Training resistance can be used to improve muscle function and maintain strength. Therefore, the process of aerobic exercise is very important for people with poor blood glucose regulation, and it can also provide more meaningful and targeted concept development for the treatment of diabetes. In order to promote the development and application of SAR map, this paper studies the relationship between abnormal precipitation in rainy season and blood glucose regulation of teenagers during aerobic exercise, and applies it to the study of SAR map.

Keywords High-resolution SAR image · Abnormal precipitation in rainy season · Aerobic exercise · Blood glucose regulation

Introduction
Remote sensing image change detection is a technology to monitor the earth's environment and security by comparing the image data of different phases in the same region (Lee et al. 2001). Compared with optical remote sensing, synthetic aperture radar (SAR) plays an important role in detecting changes due to all its imaging weather patterns. This technology is widely used in various fields, such as agricultural services and urban monitoring, and has become the object of national development and research. There are two methods to detect uncontrolled changes in high-resolution SAR images: pixel detection and object level detection. The former is sensitive to the difference of different images and radiated noise, and ignores the integrity of the target. Object level detection method uses image speckle as the computing unit of image analysis, which is consistent with human cognitive logic, and allows extensive use of object feature information, spatial information, and texture information (Ma et al. 2013). Therefore, on the basis of object-oriented idea, this paper uses a lot of detailed information about SAR image, and deeply studies the recognition accuracy of high-resolution SAR image, proposes a method of rainfall anomaly detection in rainy season, and a distance adaptive weight determination method based on gray gipo and gistogram of LBP texture (Makealoun et al. 2015). The first one is a regression equation based on the low frequency signal of the precipitation anomaly series in rainy season, which can give a more accurate forecast about half a month in advance; The second model is based on the original
transformed based on the first k-component of EOF, which makes the high value region of principal component correlation concentrated in a small range, so that each principal component after rotation can focus on reflecting some local information; Therefore, it is often used for climate zoning (Santini et al. 2009).

Research methods

High-resolution SAR image

The noise in SAR image mainly comes from scattering echo. In a certain area of the radar image, even if the backscattering physical characteristics of the ground object are stable (also known as “uniform area”), the size of the target is much larger than the wavelength of the electromagnetic wave emitted by the radar, so it still looks like it is composed of pixels (Suzen and Doyuran 2004).

There are some speckles in radar image, which is the result of speckle noise. This phenomenon is also called multiple noise. As shown in formula (1):

\[ I(x, y) = f(x, y) + t(x, y) \]

where \( I(x, y) \) is the observed data, \( t(x, y) \) is the speckle noise, and \( f(x, y) \) is the ideal data not affected by noise theoretically. It can be seen that speckle noise suppression is to extract or filter speckle noise from the observed image data.

Precipitation anomaly analysis function

Empirical decomposition mode (EMD) ensemble is a time series analysis technique based on EMD, which is suitable for nonlinear and nonstationary time series analysis. Theoretically, it can be used for any type of signal decomposition, because it does not need to set the basic function in advance; Therefore, it has been widely used in meteorology, hydrology, and mechanical engineering. It can decompose complex one-dimensional data into a limited number of volatility components with different time scales, that is, a limited number of eigenmode functions and trend terms res. each fund reflects the local characteristics of the original series with different time scales.

First order Butterworth bandpass filter can be written as follows:

\[ y_k = a(x_k - x_{k-2}) - b_1y_{k-1} - b_2y_{k-2} \]

\[ a = \frac{2\Delta K}{4 + 2\Delta K + K_0^2} \]

\[ b_1 = \frac{2(K_0^2 - 4)}{4 + 2\Delta K + K_0^2} \]

Materials and methods

Research materials

There are four types of data used in this paper; one is the daily precipitation data of each station in Southwest China. Due to the sparse distribution of meteorological stations in a certain area and the lack of effective precipitation observation in a large area of Western China, the data in this paper mainly come from 339 stations in four provinces and cities: A, B, C, and D; Another kind of data is reanalysis data from European center in the same period, including sea level pressure field, specific humidity, horizontal wind speed, and potential height with spatial resolution of 2.5 \( \times \) 2.5. The third type of data comes from the long wave radiation data of the National Oceanic and Atmospheric Administration (NOAA), with a resolution of 2.5 \( \times \) 2.5. The fourth data type is the MJO index of the Australian Meteorological Center (Sangchini et al. 2015).

Empirical orthogonal function (EOF) variable field can be decomposed into the product of time function and space function, and the basic spatial characteristics and time evolution of source field can be expressed in as few patterns as possible; The rotated empirical orthogonal function (REOF) is a linear equation, adding eight influence factors of low-frequency series; It can give a more credible forecast conclusion 20–25 days in advance; In addition, the prediction effect of the two models for the years with more precipitation is better than that for the years with less precipitation. In aerobic exercise, we observed the life of dozens of patients and compared them (Martha et al. 2019).

The results showed that the compound nursing training can effectively improve the quality of life of young people with low blood glucose regulation. The reason may be that skeletal muscle is the main place to consume most of the blood glucose (Rickli and Graf 2009). Exercise will cause muscle hypoxia when loading, and then make the protein transporter move to the cell surface, so as to promote the transport process, which has a great role in promoting the prognosis of the disease (Mousavi et al. 2011). Those with low blood glucose regulation in the study received scientifically directed exercise to maximize the effect of aerobic exercise (Pham et al. 2016). When there was no difference in the amount of aerobic exercise, there was no difference in the improvement of blood glucose, blood lipid, body weight, and body composition between moderate intensity and high intensity, but intensive aerobic exercise could significantly improve the cardiopulmonary endurance of T2DM patients. For example, T2DM can choose a more appropriate aerobic choice according to cardiopulmonary endurance and training time, while low-level patients can achieve the goals of blood glucose regulation, fat regulation, and body composition improvement by participating in moderate intensity training (Nguyen et al. 2019).
The blood lipid level of the observation group was better than that of the control group (P < 0.05). This shows that training can effectively reduce the lipid level of diabetic patients and improve metabolism level. Endurance exercise can stimulate skeletal muscle, increase capillary quantity, promote expression of protein membrane gene, increase the activity of lipoproteins in skeletal muscle, thus make the body eat more fatty acids and improve fat metabolism. Muscle is the main target cell of insulin. During the loading process, stimulation will make them expand to a certain extent, thus increasing the transverse region, increasing the number and sensitivity of insulin receptors, and finally effectively improving insulin resistance. Aerobic exercise can promote fat, improve lipase activity, and promote cholesterol and fat utilization substances, thus reducing the endogenous synthesis of fat (Yalcin et al. 2011). The combination of two methods of exercise and training can help patients improve their physical condition to the greatest extent.

### Results

#### Seasonal variation characteristics of precipitation in rainy season

According to the monthly evolution of precipitation level in Southwest China (Fig. 4), it can be seen that the precipitation in Southwest China shows obvious dry and wet conversion characteristics, and the precipitation mainly concentrates in May October. The local difference is significant, the time of entering and exiting the rainy season is different, and the rainfall size is also different. In April, the precipitation level in the eastern part of Southwest China was the first to turn to positive.

In May, the positive area further expanded, the anomaly value in the eastern region was greater than that in the western region, and the rainy season began in Southwest China; To some extent, this reflects that the rainy season in Southwest China is advancing from east to west. In June, the positive anomaly covered the whole area of Southwest China, and the intensity increased significantly, and the main value area was located at the junction of a and C. In July and August, the precipitation in Southwest China is the most concentrated period, and the positive anomaly is more than 60mm in the whole region, especially in southern China, where the positive anomaly is more than 150mm. However, it is worth noting that the two maximum precipitation areas only appear in midsummer, but are not obvious in other months. In September, the precipitation decreased rapidly, and most areas maintained a weak positive anomaly, but it has entered a relatively less rainy period; This seems to reflect that the end of the rainy season in Southwest China is also advancing from east to west. October is the transition season of dry wet transition in Southwest China. The absolute value of precipitation anomaly in the whole region is less than 30mm, and the positive and negative value areas alternate. Therefore, it is generally considered that may to October is the rainy season in Southwest China.

\[
b_2 = \frac{4-2\Delta K + K_0^2}{4 + 2\Delta K + K_0^2}
\]

In which,

\[
\Delta K = 2\left| \frac{\sin(k_1\Delta T) - \sin(k_2\Delta T)}{1 + \cos(k_1\Delta T) + 1 + \cos(k_2\Delta T)} \right|
\]

\[
K_0^2 = \frac{4\sin(k_1\Delta T) \cdot \sin(k_2\Delta T)}{[1 + \cos(k_1\Delta T)] \cdot [1 + \cos(k_2\Delta T)]}
\]
Spatial anomaly characteristics of precipitation in rainy season

Influenced by the summer monsoon and complex terrain, the spatial and temporal difference of precipitation in Southwest China is very obvious. In order to deeply understand the regional anomaly characteristics, firstly, EOF decomposition of precipitation standardized anomaly fields of 339 stations in Southwest China is carried out. Then, the first 10 EOF principal components and corresponding load vectors are extracted and rotated. Then, through the analysis of decomposition results, we can see the distribution characteristics of precipitation in southern China. The differences can be seen in Table 1: the cumulative deviation contribution rate of the first 10 load vectors is as high as 66.6%, which mainly contains the basic information of the rainy season precipitation field in Southwest China; After rotation, the total cumulative variance contribution remains unchanged, but the variance contribution of each rotation load vector is redistributed, and the variance contribution is no longer arranged in the order of magnitude; In contrast, the distribution of variance contribution of rotation load vector is more uniform, that is to say, the information of original precipitation field expressed by rotation principal component is more balanced, and it can focus on local information.

Figure 2 shows the spatial distribution of the first three modes of EOF decomposition, and the cumulative variance contribution rate reaches 47.6%, which basically reflects the spatial distribution pattern of precipitation anomalies in Southwest China. In the first mock exam China (2a), the variance is the largest, which is 26.3%. It is the main form of precipitation in Southwest China, reflecting the characteristics of unanimous change in the whole region, showing the inconsistency with most other parts of Southwest China. The contribution of variance in the second mode (Fig. 2b) is 13.8%, which is mainly characterized by the reverse change between the East and the West. The negative values are mainly located in a and b, while B and a are the positive ones. The first mock exam is China’s southwest subtropical high. When the subtropical high is eastward, the southeast China is affected by
the warm wet gas flow in the southwest of the subtropical high, with abundant precipitation resources. When the subtropical high is to the west, the eastern part is controlled by the subtropical high, and the precipitation decreases, while the western part increases. The third mode (Fig. 2c) reflects the North–South reverse characteristics of precipitation, and the zero line is basically 28°N latitude; The absolute value of the load vector is larger in the positive area of the north, and the interannual precipitation anomaly is significant; In the western part of the basin, the negative area protrudes upward into the positive area, which may be related to the rapid change of topography in the area.

EOF decomposition results show that the precipitation in southern China has great directional differences, and its distribution is not planned, which is very complex. In order to explore the local characteristics of precipitation, the REOF decomposition results are further discussed. Based on the maximum/minimum region (absolute value greater than 0.4) of rotation load vector, the main anomaly spatial types are defined, and six precipitation anomaly regions are obtained from the first six REOF modes.

REOF the first mock exam (Fig. 3a), the large value area is mainly located in a province, often located at the intersection of East Asian monsoon and South Asian monsoon, and abundant rainfall resources. The rotation load vector decreases from southwest to northeast of China, and Lincang station is the largest, which is called a region. The second mode (Fig. 3b), the large value area in the D Province, the center is -0.84, is mainly affected by the southeast monsoon rain area in summer. Third mode (Fig. 3c), the large value area is mainly located in the eastern part of a basin, and the largest center is located in Bazhong, which is called the eastern part of the basin. In the fourth mode (Fig. 3D), the area with absolute value greater than 0.4 is located in the plateau area with higher altitude in the West.

**Table 1** Variance contribution rate of top 10 modes of EOF and REOF decomposition of rainy season precipitation in Southwest China (unit:%)

| No. | EOF Variance contribution (%) | Cumulative variance contribution (%) | REOF Variance contribution (%) | Cumulative variance contribution (%) |
|-----|-------------------------------|-------------------------------------|--------------------------------|-------------------------------------|
| 1   | 26.3                          | 26.3                                | 15.4                           | 15.4                                |
| 2   | 13.8                          | 40.1                                | 15                              | 30.3                                |
| 3   | 7.6                           | 47.6                                | 5.1                             | 35.4                                |
| 4   | 4                            | 51.6                                | 7.7                             | 35.4                                |
| 5   | 3.7                           | 55.3                                | 6.2                             | 43.1                                |
| 6   | 3.1                           | 58.4                                | 4.8                             | 49.3                                |
| 7   | 2.6                           | 61                                  | 2.2                             | 54.1                                |
| 8   | 2.1                           | 63.1                                | 5.2                             | 56.2                                |
| 9   | 1.8                           | 64.9                                | 2.9                             | 61.4                                |
| 10  | 1.6                           | 66.6                                | 2.3                             | 64.3                                |

**Temporal variation characteristics of precipitation in rainy season**

Figure 4 shows the evolution and linear trend of standardized anomaly of total precipitation in each region; In order to analyze the decadal variation of precipitation, the moving average curve is also given. After looking at the long-term trend of precipitation in each region, we find that although the situation in each region is decaying, it fails to pass the test, indicating that although the precipitation in most areas of Southwest China is declining, the decreasing trend is not significant.

Figure 5 shows the average number of precipitation abnormal years in six regions selected by sliding. Figure 5A shows that the precipitation is abnormal decrease in every 1.5 years, and has increased to about 2.7 years by the beginning of the 21st century, and the number of juvenile precipitation is significantly increased; The number of years of precipitation anomaly shown in Fig. 5B shows a downward trend; Both of them passed 95% of the significance test. Under the background of global climate change, the total precipitation in the rainy season in Southwest China has decreased, and the frequency of abnormal precipitation is increasing, which may lead to the aggravation of drought in Southwest China.
Results of aerobic exercise in adolescents

Table 2 shows the basic characteristics of each group before the experiment. There was no significant difference in each index among group C, group E, and group E + D, which indicated that the characteristics of each index were the same among the three groups before the experiment, so the randomized grouping scheme of this study met the basic requirements of randomized grouping experiment.

Table 3 shows that there are no significant differences in IMt, WC, fat percentage, visceral fat, blood glucose, insulin, and HOMA-IR between TF and TA genotypes (P > 0.05).

The effects of intervention on body composition and insulin resistance of overweight and obese college students with different genotypes are shown in Table 4.

The interaction effect of intervention and FTO gene polymorphism on waist circumference change is shown in Fig. 6.

The interaction effect between intervention and BMI change of FTO gene polymorphism is shown in Fig. 7.

The interaction effect of intervention and FTO gene polymorphism on the change of body fat percentage is shown in Fig. 8.

The interaction effect of intervention and FTO gene polymorphism on blood glucose is shown in Fig. 9.

The results of this study showed that the effects of exercise and institutional intervention programs on different types of genes were significantly different, reflecting a decrease of 2.9 cm in the discipline circle of TT cycle group and 9.64 cm in the discipline circle of TA cycle group. In other words, for IMT, there is an important critical interaction between human fat percentage, blood glucose level and HOMA-IR, intervention program, and genotype. The percentage of fat, visceral fat index, and blood glucose in Group E were significantly lower than those in group C. The decrease of blood fat and sugar content around the size of ECB group was significantly higher than that of C group. According to other indicators, there is no significant difference between the intervention plan and different types of genes, that is, there is no significant interaction. These data indicate that exercise diet and FTO gene intervention have different interaction effects on some indexes in this study, that is, intervention has different indexes related to obesity and diabetes in different FTO genotypes.

Discussion

Analysis of precipitation anomaly in rainy season

Based on the daily precipitation data of stations in Southwest China, this paper analyzes the temporal and spatial distribution characteristics of precipitation in Southwest China, and delimits the start and end dates, length and precipitation of rainy season in Southwest China by using industry standards...
Fig. 4  The standardization distance of total precipitation in rainy season in each area is flat (column line), sliding average (solid line), linear trend (dotted line).

Fig. 5  The average number of abnormal years of precipitation in the six sliding areas (a. the number of years of precipitation, b. the number of years of precipitation).
Lee and Pradhan (2007). Secondly, the evolution characteristics of the high and low-level atmospheric circulation and water vapor transport field in Southwest China before and after the beginning and end of the rainy season are explored by the method of synthetic analysis. Then, the low-frequency characteristics of Precipitation Series in Southwest China are analyzed, and eight phases are divided according to the 20–60-day intraseasonal oscillation of precipitation to explore the low-frequency physical factors related to the Intraseasonal Oscillation of precipitation in Southwest China. Finally, two methods are used to predict the Intraseasonal Oscillation of the rainy season in Southwest China (Althuwaynee et al. 2014).

Before the beginning of rainy season in Southwest China, 10°–30°. At the end of April, the high OLR value zone was broken near Indochina Peninsula, and the two low OLR value zones in the north and South were opened up, forming and maintaining the distribution pattern of “high in the West and low in the East” during the whole rainy season; At the end of the rainy season, the high value zone is reconstructed in Southwest China. Before the beginning of the rainy season, easterly winds prevailed in the low latitudes of the northern hemisphere; At the end of April, the easterly zone near Mengwan was broken, and the southerly air flow appeared; In the first ten days of May, the cross equatorial flow appears and strengthens gradually. By the end of May, the whole southwest of China was affected by the warm and humid air flow, and the rainy season began; At the end of the rainy season, the easterly zone was about 20° reconstruction of the area south of n (Arora et al. 2004). The corresponding relationship between the distribution of water vapor transport flux field in the whole layer before and after the rainy season. At 200 hPa, the onset of rainy season in Southwest China was accompanied by the South Asia high from 150 HPA °. The Pacific Ocean to the east of e gradually moved to Indochina Peninsula and plateau; At the end of the rainy season, the South Asia high moved out of the plateau and returned to the Pacific Ocean (Kritikos and Davies 2015).

Analysis of blood glucose regulation during aerobic exercise in adolescents

Previous studies have argued that mutations in the FTO gene are strongly associated with obesity in British adults and children. The study on the genomes of 38759 subjects found that FTO gene mutation was closely related to diabetes. And we also found that the correlation between FTO and diabetes would disappear through the observation model (Kaur et al. 2018). This study also showed that the frequency of ftors939609 locus B and other genes was 0.24, which was close to the detection rate of large samples (Baeza and Corominas 2001). No homomorphic mutation a/a possibly caused by the small sample size was detected in this sample. In addition, this study will compare the FTO gene polymorphism and obesity and diabetes related indicators before intervention (Kayastha et al. 2013). Compared with TT genotype, TT genotype may be associated with IMT, waist circumference, body fat rate, visceral fat index, blood glucose, insulin, and HOMA-R genotype in small sample size. Therefore, the effect of FTO risk allele on obesity and diabetes is worth studying (Chae et al. 2017).

Table 2 Basic characteristics of three groups before experiment

| Indicator          | n=25 Group C (M+SD) | n=25 Group E (M±SD) | n=25 Group E+D (M +SD) | P    |
|--------------------|--------------------|-------------------|------------------------|------|
| Height/cm          | 175.62±6.91        | 174.15+4.88       | 175.57+5.02            | 0.59 |
| Weight/kg          | 86.81±11.78        | 87.11+10.67       | 87.05 +8.58             | 0.78 |
| TA/TT              | 6/19               | 1/4               | 7/18                   | 0.8  |
| BM/(kg.m~2)        | 28.05±2.43         | 29.20+2.81        | 28.22+2.37             | 0.23 |
| VO2max/min~1       | 2.72±0.38          | 2.52+0.35         | 2.57±0.31              | 0.11 |
| Body fat rate/%    | 36.97±6.58         | 38.51±6.77        | 36.42±5.83             | 0.49 |
| Visceral Fat Index | 11.14±4.01         | 11.60±3.51        | 11.20+3.43             | 0.59 |
| Waist circumference/cm | 98.32±8.18       | 100.00+8.63       | 97.16+7.01             | 0.45 |
| Blood sugar/(mmol.L~1) | 5.11±0.46         | 5.07±0.45         | 5.20±0.38              | 0.56 |
| Insulin/(uU.mL~1)  | 17.02±6.92         | 20.50+14.21       | 17.80+12. 63            | 0.65 |

Table 3 The relationship between FTO rs9939609 locus polymorphism and obesity and diabetes related indicators

| Indicator         | TT(n=57)         | TA(n=18)          | P    |
|-------------------|------------------|------------------|------|
| Body weight       | 28.47±2.51       | 28.56±2.80       | 0.78 |
| WC/cm             | 98.75±7.89       | 97.67±8.32       | 0.66 |
| Body fat rate/%   | 37.54±6.56       | 36.55±5.91       | 0.61 |
| Visceral Fat Index| 11.47±3.63       | 10.81±3.64       | 0.52 |
| Blood sugar/(mmol.L-1) | 5.11±0.45      | 5.18+0.33        | 0.59 |
| Insulin/(uU.mL-1) | 19.15±11.77      | 19.42+10.54      | 0.57 |
| HOMA-IR           | 4.16±2.81        | 4.49±2.52        | 0.57 |
It is found that exercise can improve patients in all aspects, and FTO gene also plays a significant role in patients, which means that the same intervention may have different effects on people with different FTO genotypes, or gene mutation may change the effects of exercise and other factors on people. For example, Ruiz studied 785 European adolescents and found that the FTO rs9939609 allele was positively correlated with IMT, body fat ratio and waist circumference, but the FTO gene mutation had little effect on body weight greater than or equal to 1 h a day. Each copy of the risk allele increased fat by 0.4% and waist circumference by 0.6 cm, while those who did not exercise as much as recommended increased fat by 1.7% and waist circumference by 1.15 cm. This study shows that a certain amount of exercise load can reduce the impact of FTO gene mutation on the body (Chang and Chiang 2009).

The results showed that exercise and diet intervention had significant differences in abdominal circumference of different genotypes (Chau and Y. F. T. 2004). The waist of TT group was 2.89 cm lower, and Ta type decreased by 9.64 cm. That is, the important significant interaction between intervention procedure and genotype, the body fat, glucose, insulin, and body composition in blood were significantly reduced compared with group C after dry prognosis. The fat ratio, visceral fat index, and blood glucose value of group D were significantly lower than those in group C, and the waist decrease, fat ratio, and blood glucose value of E and B group were significantly higher than those in group C (Dapples et al. 2002). There was no significant difference in the effect of intervention procedure on different genotypes, that is, the interaction had no significant effect. These data indicate that exercise diet and FTO gene intervention have different interaction effects on some indexes in this study, that is, intervention has different indexes related to obesity and diabetes in different FTO genotypes (Cogan and Gratchev 2019).

At present, there are few studies on the exercise or intervention lifestyle on the genome FTO individuals that lead to incompatible results (Fell et al. 2008). Aldy: Hans investigated the impact of lifestyle interventions (exercise and Nutrition) on obese children with different FTO genes. The results showed that IMT, fat content, and HOMA IR value decreased sharply after 6 months of intervention (Kanungo and Sharma 2014). But there was no significant difference among different genotypes, suggesting that risk alleles also benefited from the health effects of exercise and dietary intervention.

### Table 4

The effect of intervention on body composition and insulin resistance of overweight and obese college students with different genotypes

| Indicator        | Group C (M±SD) | Group E (M±SD) | Group E+D (M±SD) |
|------------------|----------------|----------------|------------------|
|                  | TT (n=19)      | TA (n=6)       | TT (n=20)        |
| BMI (kg.m⁻²)     | -0.54±0.81     | -0.29±0.84     | -1.67±1.63*      |
| Waist circumference (cm) | -2.89±2.90 | -3.17±2.79     | -4.65±3.60      |
| Body fat rate (%) | -1.80±2.72     | -0.55±0.61     | -11.22±6.72*     |
| Visceral Fat Index | -1.08±1.92     | -0.33±1.54     | -1.48±2.18      |
| Blood sugar (mmol.L⁻¹) | -0.44±0.31     | -0.42±0.22     | -0.35±0.33      |
| Insulin (uU.mL⁻¹) | -5.82±5.23     | -3.42+10.17    | -7.00+13.26     |
| HOMA-IR          | -1.51±1.19     | -1.04±2.26     | -1.81±2.96      |

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Fig. 6 Interaction effect of intervention and FTO gene polymorphism on waist circumference

Fig. 7 Interaction effect of intervention and FTO gene polymorphism on BMI
In this study, it was found that the blood glucose index was better than that of the first group ($P < 0.05$), and the control group indicated that the combined training of the lactators could improve the blood glucose index of young diabetic patients (Guzzetti et al. 2005). The main reason is that the combination of aerobic exercise and preparation resistance is more effective than single exercise in improving insulin sensitivity, and can balance blood sugar by regulating the metabolism of sugar and lipid in the body, and then make the blood glucose level of patients tend to be normal (Harilal et al. 2019). The patient is getting fat gradually because of the life, work tension, irregular work, and rest diet. However, the body still has good response and adaptability due to the age. Through aerobic exercise, the heart and lung function of patients can be effectively exercised, and the cardiovascular system of the body can be more effective and quickly transmitted to each part of the body, which can promote the coordinated development of waist and limb strength, make the body composition ratio of patients more reasonable and reduce the weight of fat; Resistance training can also delay the aging of the patient muscle, increase the flexibility, balance and coordination of the body, improve the basic rate of metabolism, and energy consumption of patients, thus reducing the body fat accumulation and ultimately improving the glucose index in the blood of the patients (Hemasinghe et al. 2018).

**Conclusion**

In the comparative analysis of water extraction methods in high-resolution SAR satellite remote sensing images, according to the experimental sites of water samples in TerraSAR-X, Cosmo-Skymed, and sentinel-1a satellite images, the filtering effect is analyzed by using adaptive median filter, frost filter and improved lees filter, and the accuracy of water intake results before and after filtering is quantified. The image filtering of TerraSAR-X satellite and Cosmo-Skymed greatly improves the image quality. The filtering of lees and the improved Lee filter have obvious influence on the noise of coherent spots in these images; The same water extraction area growth algorithm was used to extract the water of the images before and after filtering, and the quantitative extraction accuracy changed significantly. The water extraction effect of the images before and after the TerraSAR-X satellite filtering was significantly changed, about 10%. The other two kinds of image filtering had little change in water extraction before and after filtering. However, exercise and diet intervention can significantly improve the composition and blood glucose level of subjects. Exercise and diet have a great influence on the study of waist circumference, indicating that the mutation of FTO gene can change or affect the health impact of college students. Even for people who are prone to obesity, meaningful physical exercise and diet intervention can effectively promote weight loss. If we can keep exercising and controlling diet every day, it is very helpful for their health, especially for students in University, we should pay more attention to their health, manage their habits, and strengthen their physical quality.

**Fig. 8** Interaction effect of intervention and FTO gene polymorphism on body fat percentage

**Fig. 9** Interaction effect of intervention and FTO gene polymorphism on blood glucose

**Fig. 10** Interaction effect of intervention and FTO gene polymorphism on changes of HOMA-IR
Declarations

Competing interests The authors declare no competing interests.

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