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Review Article

The value of miRNAs in the prognosis of obese patients receiving bariatric surgery

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Abstract: Bariatric surgery has been the first-line treatment for obesity. Since the 2010s, gradual changes in miRNAs upon surgery have been observed. Substantial research has been undertaken on the role of bariatric surgery in the gastrointestinal tract. However, bariatric surgery research largely ignores the role of miRNAs in organs other than the gastrointestinal tract, while the contribution of miRNAs to this process has received little attention. This review addresses a neglected aspect of miRNAs in obese patients undergoing bariatric surgery, especially the obvious effect on multisystem organs. This finding provides evidence that miRNAs play a complex yet important role in the functional stability of each organ and the weight loss efficacy after bariatric surgery. The results provide a solid evidence base for the mechanism of bariatric surgery. Taking into account incompatible medication adherence associated with adverse outcomes, suggestions were identified for an efficient technical refinement of bariatric surgery with better clinical results.

Keywords: Bariatric surgery, miRNA, digestive system, cardiovascular system, urinary system, nervous system

Introduction

Obesity and related diseases affect 50% of the world's population, and bariatric surgery is one of the most cost-effective interventions for long-term weight loss [1]. Although it has a significant weight loss effect, a detailed understanding of the molecular mechanisms behind the success of bariatric surgery is required. The long-term outcomes of bariatric surgery in patients with severe obesity are no longer limited to the gastrointestinal tract, as whole-body homeostasis includes organ function [2, 3]. Consequently, the exploration of the mechanisms of bariatric surgery should focus on the various systemic organs and pay attention to the close connection between them. Fortunately, whole transcriptome analysis reveals differential gene expression profiles reflecting the characterization of organ reactions after bariatric surgery [4]. The results revealed that miRNAs play an important role in the process of weight loss after bariatric surgery, implying that they have great prospects for surgical action and new approaches to reduce postoperative adverse reactions. Given the fundamental contradictions among bariatric surgery and medical therapy [5], prospective proposals for the further development of bariatric surgery should be provided.

Digestive system

Bariatric surgery is directly related to the digestive system, including laparoscopic sleeve gastrectomy (LSG), endoscopic sleeve gastroplasty (ESG), and Roux-en-Y gastric bypass (RYGB) [6, 7]. Thus, there is currently no doubt about the influence of bariatric surgery on the digestive system. Among them, miRNAs are essential for regulating gene expression.

Gut microbiota

The adverse consequences of a reduction in gut microbiota diversity and micronutrient deficiencies are some of the harmful mechanisms that occur in obesity, while bariatric surgery can effectively alleviate the mentioned problems [8]. In the context of obesity, increasing lipopolysaccharide (LPS) and lipopolysaccharide-binding protein (LBP) are some of the major causes of disturbances in the gut microbiota, which exacerbates low-grade inflammation and insulin resistance [9]. As indicated previously, a

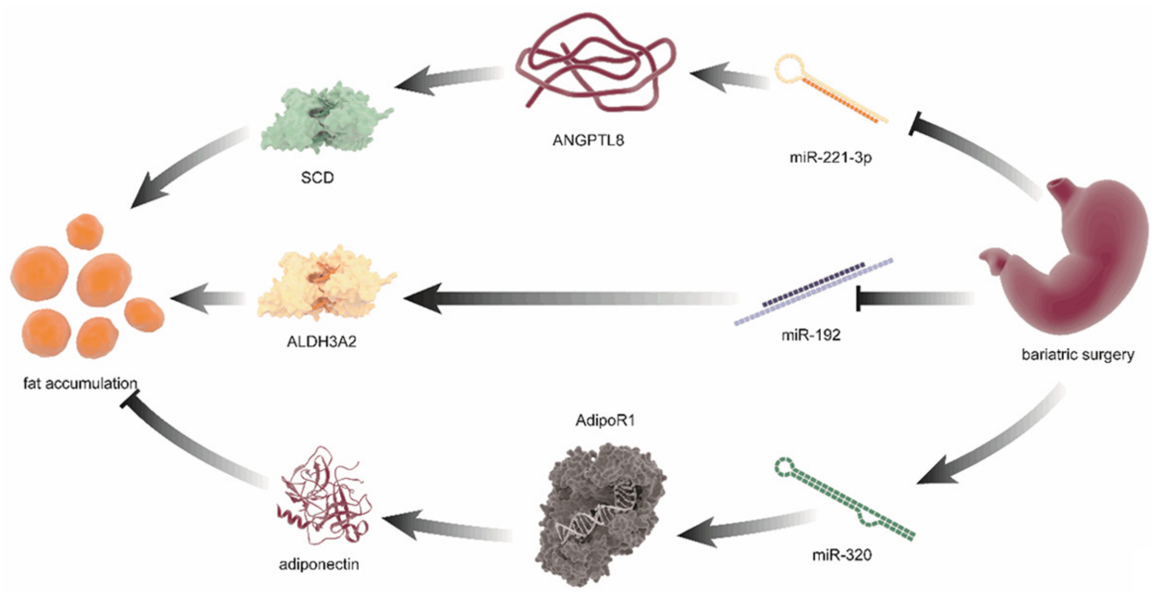

Figure 1. Bariatric surgery suppresses fat accumulation via the miRNA-associated pathway. Bariatric surgery can inhibit fat accumulation and thereby regulate lipid metabolism through 3 different pathways. First, miR-221-3 is downregulated, resulting in decreased levels of angiopoietin-like 8 (ANGPTL8), which could lead to a decrease in SCD (stearoyl coenzyme A desaturase 1) and result in a decrease in fat accumulation. Second, bariatric surgery directly promotes the inhibition of fatty aldehyde dehydrogenase ALDH3A2 (a member of the aldehyde dehydrogenase 3 family A2, which increases circulating lipid levels and leads to fat accumulation) by downregulating miR-192. Third, bariatric surgery facilitates AdipoR1-mediated adiponectin function by promoting miR-320 expression.

significant decrease in LPS and LBP, along with symptomatic and functional remission such as inflammation, in patients with obesity can be observed after bariatric surgery [10]. It should be noted that upregulated expression of miRNAs may be involved in the LPS and LBP downregulation including miR-146a and miR-103a [11]. Although no evidence is available yet for determining that miRNA expression regulatory mechanisms improve the human gut microbiome after bariatric surgery, increasing evidence points towards the existence of a bidirectional interconnection, and it is clear that there is some connection between miRNA and gut microbiota [12]. Taken together, these findings suggest a role for miRNA in promoting homeostasis with the intestinal microbiota after bariatric surgery, but further experimental investigations are needed to estimate the predictive value of preclinical research.

Lipid metabolism

Regulating lipid metabolism is one of the key factors in bariatric surgery. Bariatric surgery is associated with increased lipid peroxidation, thus improving the excess storage of lipids [13]. After bariatric surgery, downregulation of the adipogenic enzymes SCD (stearoyl coenzyme A desaturase 1) and the fatty aldehyde dehydrogenase ALDH3A2 (a member of the aldehyde dehydrogenase 3 family A2) can significantly reduce fat accumulation, while it has been demonstrated that SCD and ALDH3A2 are direct targets of miR-192 [14]. Angiopoietin-like 8 (ANGPTL8) has been shown to be a regulator of SCD and ALDH3A2 and is required for lipid storage and metabolism. In the pathophysiology of obesity, miR-221-3p can reduce protein expression in adipocytes by targeting ANGPTL8, and the miR-221-3p and miR-192 contents are significantly decreased and a negative correlation with ANGPTL8 was observed under bariatric surgery [15]. Impaired lipid metabolism may also modulate adiponectin levels and even suppress gluconeogenesis [16]. Fortunately, activation of miR-320 reduces AdipoR1 expression after bariatric surgery, which mediates adiponectin signaling and function leading to long-term remission in disorders of lipid metabolism and gluconeogenesis [17] (**Figure 1**). An increasing number of studies has revealed that lipid metabolism can be regulated in bariatric surgery by miRNA. However, lipid metabolism is very complicated and is strongly associated with the intestine, liver, and other organs. Therefore, focusing on lipid metabolism in various organs can provide a conceptual framework to enhance our understanding of the widespread effects of miRNA regulation after bariatric surgery, which will be described below in more detail [18].

Liver

The prevalence of obesity is closely related to nonalcoholic fatty liver disease (NAFLD) [19]. As an effective treatment for obesity, bariatric surgery also attenuates the progression of NAFLD. As early as 2013, Castro, R. E. et al. had discovered that bariatric surgery can regulate liver cell apoptosis by the miR-34a/SIRT1/p53 signaling pathway [20, 21]. Further research shed light on the differential expression of nine miRNAs (including miR-301a-3p, miR-34a-5p, miR-375, pri-miR-125b-2, pri-miR-16-2, pri-miR-26a-1, pri-miR-26a-2, pri-miR-7-1, pri-miR-7-2, and pri-miR-7-3) in patients undergoing bariatric surgery, which are speculated to be related to the progression of NAFLD to nonalcoholic steatohepatitis (NASH) [22, 23]. It is noteworthy that the expression of inflammation- and macrophage-related genes in liver tissues of patients after bariatric surgery is opposite to the reduction in miR-30b-5p, miR-139-5p and miR-422a, while the increase in miR-146b-5p is related to the decrease in FABP4, glucose metabolism and fatty acid (FA) mobilization [24]. More severe NAFLD-associated abnormalities of cholesterol metabolism are alleviated after bariatric surgery, which was attributed to miR-33 and miR-144 regulating the adenosine triphosphate binding cassette transporter (ABCA1) involved in cholesterol efflux [25]. Although obesity is often accompanied by NAFLD, the therapeutic effect of bariatric surgery on NAFLD is equivocal compared to obesity, which is probably due to the differential expression of miRNA in the liver after surgery. Therefore, it is necessary to carry out a reasonably designed study with long-term follow-up to accurately reflect the advancing role of miRNA in the treatment of bariatric surgery and NAFLD.

Pancreas

Excessive fat accumulation in the liver parenchyma cells of obese patients often leads to insulin resistance [26]. Bariatric surgery can normalize circulating exosomes and exosomal miRNAs related to the insulin-specific signal transduction, glucose homeostasis and related metabolomes [27]. Differential expression of several microRNAs (miR-7-5p, let-7f-5p, miR-15b-5p, let-7i-5p, miR-320c, miR-205-5p and miR-335-5p) was identified from the detection of pancreas cells. Among these, overexpression of members of several signaling pathways was noted, including the insulin resistance pathway [28].

The improvement in signal transduction cascades to the insulin receptor pathway after bariatric surgery may also be related to miRNAs. Recently, Bae, Y. U. et al. found that 9 pathways of miRNAs may be involved in insulin signal transduction, insulin receptor signal cascade and focal adhesions [29]. In addition, bariatric surgery can ease hyperinsulinemia and improve insulin sensitivity. The upregulation of hsa-miR-122, hsa-miR-130, and hsa-miR-132 expression along with the increase in hsa-miR-375 have been observed after bariatric surgery, while proinsulin (59% reduction), insulin (76% reduction), and c-peptide (56% reduction) all declined at the same time [30].

It is now clear that bariatric surgery can significantly reduce the function of the pancreas by adjusting the expression of miRNAs, which implies that the expression of miRNAs after surgery has a distinct influence on the pancreas. Therefore, further work is needed to assess the longer-term impact of miRNAs on the pancreas after bariatric surgery, which may help others find new methods of treatment for pancreatic disease secondary to obesity after bariatric surgery.

Immune system

For patients with morbid obesity, abnormal lipid metabolism is often associated with abnormal glucose metabolism [31]. Glucose metabolism abnormalities often result in increased secretion of proinflammatory cytokines, which in turn causes proinflammatory polarization of innate and adaptive immune cells throughout the body [32]. Bariatric surgery can ameliorate low-grade chronic inflammation caused by disorders of lipid metabolism and improve immune function impairment in obese patients [33]. In 2015, Ortega, F. J. et al. discovered the differential expression of miRNAs associated with immune responses by whole-genome and transcriptome sequencing. Further studies have concluded that impaired miRNA expression is closely related to inflammation, which is improved after bariatric surgery [34]. There is an intrinsic connection between miRNAs and different pathways including inflammation in obese patients' adipose tissue [35]. Inflammation-related miRNAs after bariatric surgery, including the significant upregulation of miR10a_5p, reduce plasma levels of proinflammatory factors such as IL-6, CRP and PAI-1 to relieve patients' inflammatory conditions [36]. Although based on a relatively small number of studies about the effect of the immune system on bariatric surgery, increasing evidence points towards the existence of an interconnection between them, and therefore, miRNA may prove essential for the success of bariatric surgery to regulate the immune system, especially the inflammatory response.

Cardiovascular system

The mechanism of the significant improvement in cardiovascular risk factors in obese patients after bariatric surgery has been confirmed to be related to miRNAs, and the improvement may be related to the inhibition of atherosclerosis and the development of coronary heart disease [37, 38] (**Figure 2**).

Blood vessels

Vascular obesity can lead to fatal arterial remodeling, such as vascular wall thickening, lumen stenosis, and atherosclerosis. After bariatric surgery, the circulating miR-122 content significantly decreases [39]. miR-122 inhibits the AMP-activated protein kinase (AMPK) signaling pathway of endothelial cells by targeting AMPK, upregulates the level of AMPK phosphorylation and leads to endothelial dysfunction [40]. Downregulation of miR-122 weakens its inhibitory effect on the AMPK signaling pathway, increases the activity of AMPK, activates endothelial progenitor cells and forms a variety of endothelial vascularization signal peptides, thus improving endothelial function (**Figure 3**).

Atherosclerosis is closely related to the increase in LDL and total cholesterol in plasma, while the high expression of miR-112 and ADAM17 in patients with dyslipidemia may lead to an increase in LDL and total cholesterol [41], which can be alleviated by bariatric surgery. Atherosclerosis may also be closely related to the proliferation of vascular smooth muscle cells (VSMCs) [42].

It has been found that the differential expression of three miRNAs (namely, miR-221, miR-21 and miR-448) in patients undergoing bariatric surgery is closely related to the function of VSMCs. In obese patients, miR-221 directly targets endothelial nitric oxide synthetase (eNOS) mRNA and reduces its expression, which renders eNOS unable to produce a low concentration of NO that is necessary to maintain the integrity of endothelial function. The downregulation of miR-221 in patients after bariatric surgery can alleviate atherosclerosis induced by a high-fat diet [43]. Bariatric surgery can reduce the level of miR-21 [44], and miR-21 inhibits apoptosis and promotes the proliferation of VSMCs, leading to vascular intimal growth. In obese patients, the expression of miR-21 in proliferative vessels was more than 5 times higher than that in normal vessels. It is noteworthy that in addition to bariatric surgery, physical exercise can also reduce these two miRNAs [45], which points out the importance of physical exercise after bariatric surgery. The level of miRNA-448 was downregulated in patients after bariatric surgery [46]. Wang et al. showed that changes in FOXO3a and FOXO4 activity changed the function of VSMCs. FOXO3a and FOXO4 are highly correlated with SIRT1, and SIRT1 has been confirmed to be the target gene of miR-448 [47], which is negatively correlated with miR-448. Bariatric surgery decreased the expression of miR-448 and therefore increased the expression of SIRT1, which significantly improved the obesity symptoms of patients. Therefore, the detection of the expression level of specific miRNAs in the peripheral blood of patients before and after bariatric surgery will help to predict the effect of surgery and deal with possible complications.

Heart

In terms of the heart and coronary artery disease, Hulsmans et al. showed that miR-181a, as a TLR/NFκB signal regulator, was highly expressed in obese patients and could cause coronary artery disease [48]. Therefore, a unified study of cardiovascular disease can further reveal the impact of bariatric surgery on the circulatory system and reduce the risk of patients.

Urinary system

Bariatric surgery can improve the renal function of patients by upregulating miR-200 and miR-192 [49], and miR-200 can downregulate the E-cadherin transcription inhibitory factor by targeting zinc E-box and homeobox 1 (ZEB1) to inhibit the transformation of renal epithelial cells into a fibroblast phenotype and improve renal fibrosis [50]. At the same time, miR-200

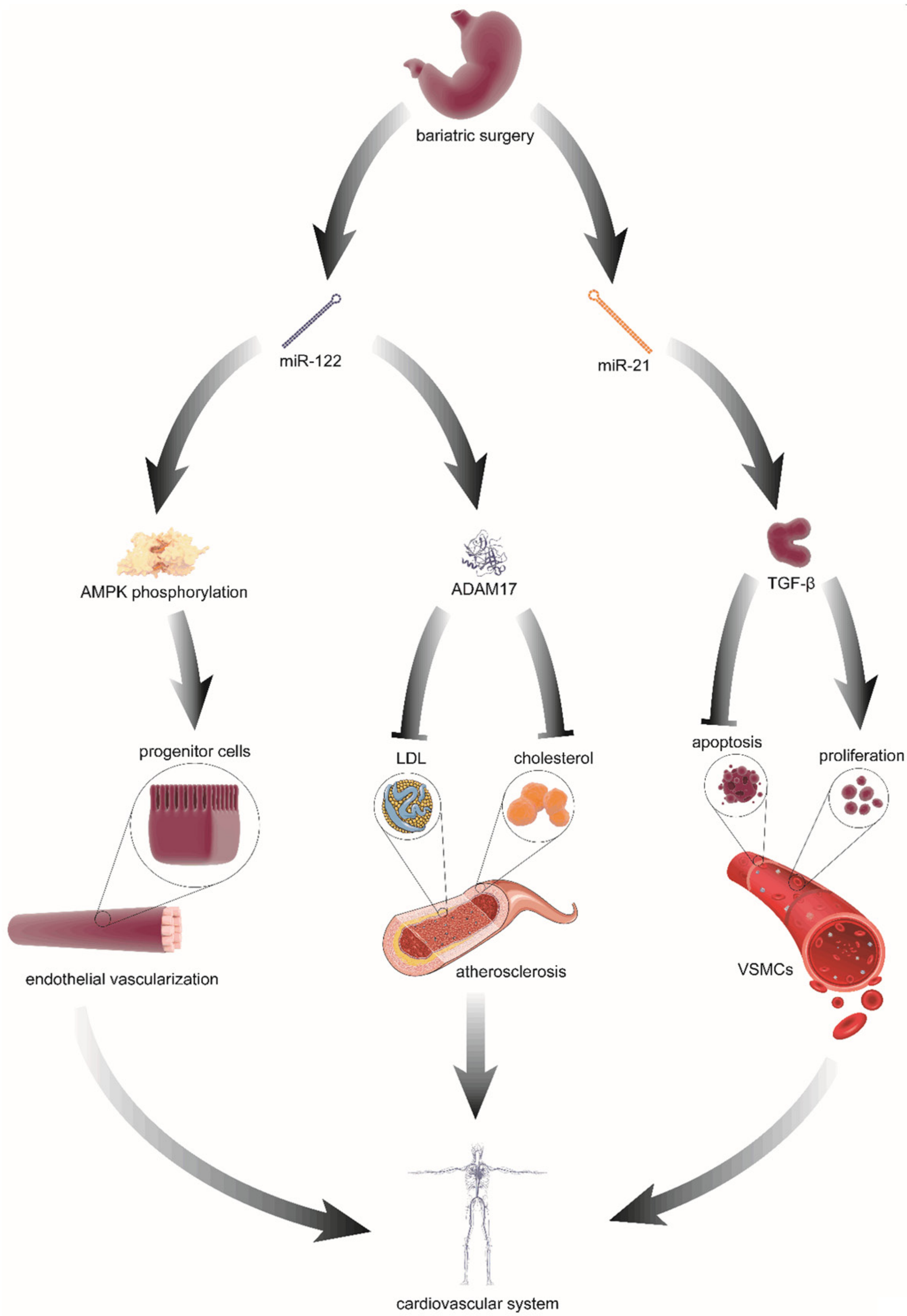

Figure 2. Bariatric surgery improves cardiovascular function via the miRNA-associated pathway. Weight loss surgery can prevent artery remodeling in three different ways and thereby improve cardiovascular function. First is down-regulates miRNA-122 resulting in decreased levels of AMPK phosphorylation, which could lead to activate the AMPK

signaling pathway of endothelial cells, result in an improvement of the endothelial function of patients; Next, directly reduces the LDL and total cholesterol content in plasma by downregulation of ADAM17 which could ameliorate atherosclerosis; Last is downregulates miR-21 resulting in the low expression of TGF-β, which could reduce the effect of the inhibition of VSMC apoptosis and the promotion of VSMC proliferation of miR-21.

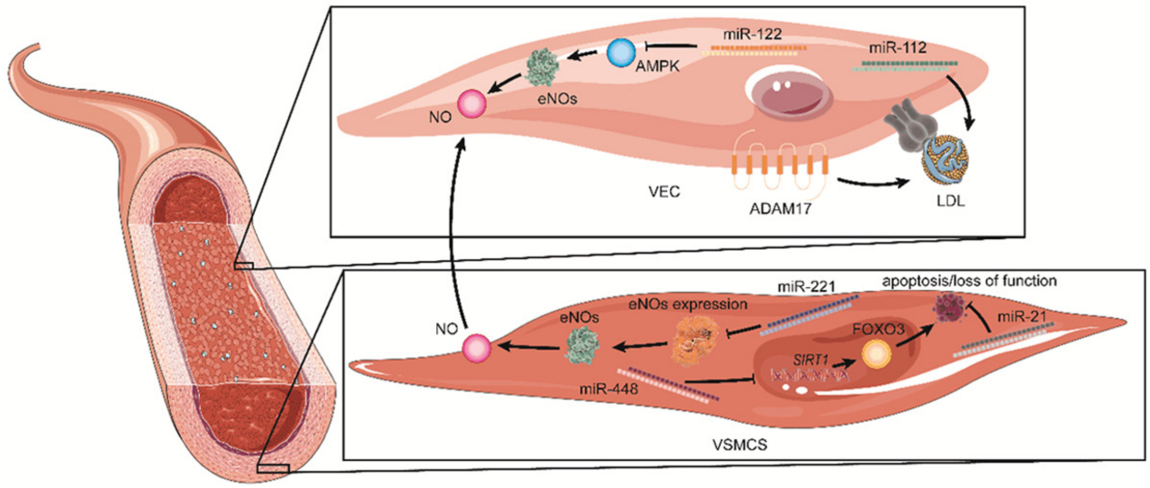

Figure 3. Important miRNAs associated with vascular endothelial cells and vascular smooth muscle cells. In vascular endothelial cells, miR-122 upregulates AMPK phosphorylation and inhibits the AMPK signaling pathway, thus reducing the production of vascular endothelial active substances. The high expression of miR-112 and ADAM17 leads to an increase in LDL. In vascular smooth muscle cells, miR-221 inhibits the transcription and translation of eNOS, resulting in a NO deficiency that fails to maintain the function of vascular endothelial cells. miR-448 inhibits the expression of the SIRT1 gene, reducing the activity of FOXO3a and FOXO4 which damaging the function of vascular smooth muscle cells. miR-21 inhibits the apoptosis of vascular smooth muscle cells.

plays an important role in the regulation of the nervous system, which will be described below in more detail. miR-192 reduced the expression of Egr-1 through the 3'-UTR, resulting in a decrease in fibronectin levels and thus inhibiting renal fibrosis [51]. The epithelial stromal transformation regulated by miRNAs is a key step in the development of chronic kidney disease [52], and chronic kidney diseases are often closely related to obesity [53, 54]. Therefore, doctors can judge the renal function of patients before and after bariatric surgery by detecting the expression of miRNAs in their urine. The expression of other miRNAs in the kidney is also worthy of further study, which may help others find new ways to improve bariatric surgery.

Musculoskeletal system

Insulin resistance (IR) is often associated with obesity, metabolic syndrome and its complications [55]. Skeletal muscle is one of the target organs of insulin, which accounts for 75% of blood sugar [56] and plays an important role in maintaining glucose balance in vivo. In 2016, Caroline et al. found that miR-148b was overexpressed in skeletal muscle cells, which reduced the levels of NRAS and Rock1 protein in muscle and then reduced the degree of PKB phosphorylation, resulting in the decreased response of muscle cells to insulin and glucose uptake [57]. It is noteworthy that only when muscle changes from an active state to an inactive state, rather than from an inactive state to an active state, can the level of skeletal muscle miR-148b be reduced, which means that exercise will have adverse effects on fat oxidation and transportation to a certain extent [58]. Therefore, it is necessary to detect the miRNA level in the muscles of patients after bariatric surgery, which can predict the recovery of patients' musculoskeletal system and help to provide scientific exercise suggestions.

Nervous system

miRNAs may also lead to obese eating behaviors by affecting the nervous system of patients. Bariatric surgery can upregulate miR-155 in patients' adipocytes [4]. In addition, Maldonado et al. have shown that miR-155 may be involved in the regulation of central feeding behavior, as miR-155 knockout mice

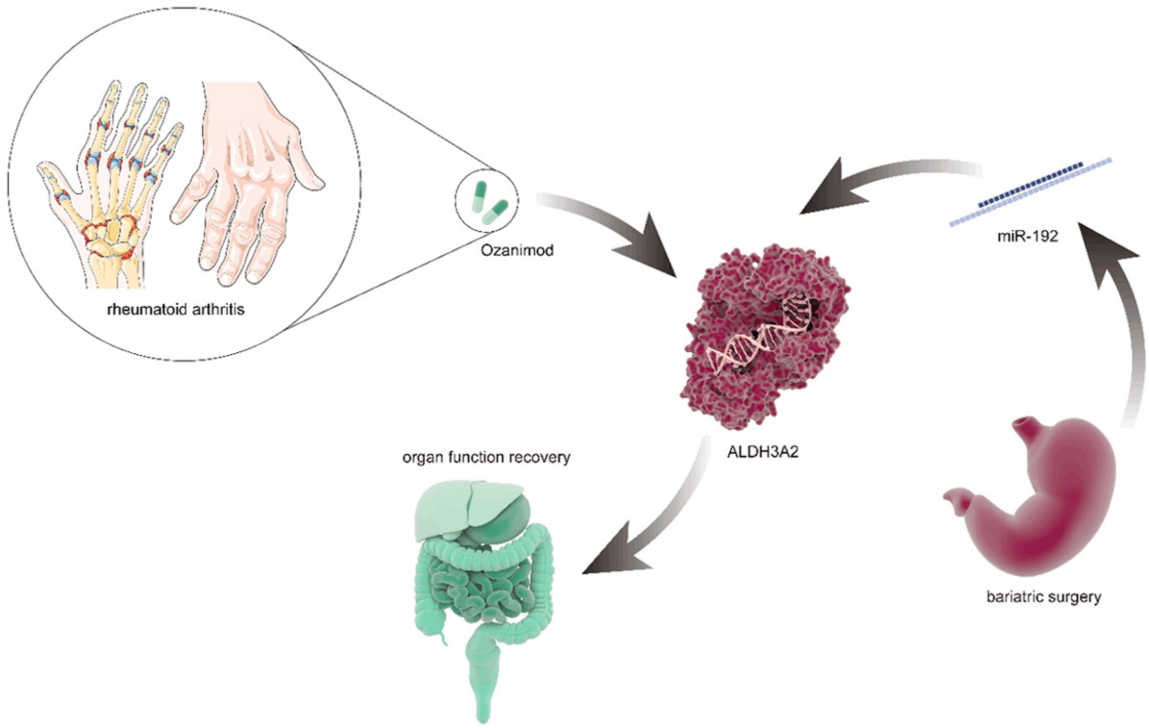

Figure 4. Drug repositioning after bariatric surgery based on genes regulated by miRNAs. Ozanimod targeting ALDH3A2 regulated by miR-192 has been approved by the FDA for the treatment of rheumatoid arthritis. Given the same putative drivers of disease associations, postoperative organ function recovery may be improved in obese patients.

unconsciously consume more fat, leading to obesity induced by a high-fat diet [59]. In addition, IRS-2 and LEPR are direct targets of miR-200. In contrast to the chronic kidney disease mentioned above [49], the hypothalamic silencing of miR-200 will increase the expression of LEPR and IRS-2 mRNA and thus reduce obesity [60]. The reason for this difference may be the different expression levels of miRNAs in different parts of patients [61]; therefore, finding a more suitable method to detect the expression of miRNAs in the nervous system of patients can further reveal the influence of bariatric surgery on the central system of patients by regulating miRNAs.

Conclusion

Obesity is a disease that is associated with multiple factors. The obesity rate in many Asian countries has continued to rise over the past two decades [62], and an increasing number of obese patients choose to undergo bariatric surgery [63] because traditional treatments (diet, exercise and drugs) to control weight have not worked [64]. This review explains the differential expression of miRNAs in the systemic system (digestive system, immune system, cardiovascular system, urinary system, musculoskeletal system and nervous system), proposes some potential biomarkers for prognosis and provides more prospective suggestions for the further development of bariatric surgery. Given that dynamic changes in the anatomical and physiological framework have an impact on the pharmacokinetics of drugs after bariatric surgery [65], this paper can be used to develop targeted pharmacological interventions aimed at improving postoperative recovery and functional status (Supplementary Table 1). For example, current applications in drug repositioning have ensured that the target genes regulated by miRNAs can potentially be used in clinical practice, which has been proven to be more cost-effective, faster, and more effective (**Figure 4**).

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Disclosure of conflict of interest

None.

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Supplementary Table 1. A gene regulatory network for miRNAs after bariatric surgery

geneID	geneName	geneType	miRNAid	miRNAname	miRNA_phenotypes	resource
ENSG00000001631	KRIT1	protein_coding	MIMAT0000076	hsa-miR-21-5p	miR-21 plays an important role in hypertension	ENCORI
ENSG00000035403	VCL	protein_coding	MIMAT0000076	hsa-miR-21-5p	miR-21 plays an important role in hypertension	ENCORI
ENSG00000065809	FAM107B	protein_coding	MIMAT0000076	hsa-miR-21-5p	miR-21 plays an important role in hypertension	ENCORI
ENSG00000115310	RTN4	protein_coding	MIMAT0000076	hsa-miR-21-5p	miR-21 plays an important role in hypertension	ENCORI
ENSG00000133104	SPART	protein_coding	MIMAT0000076	hsa-miR-21-5p	miR-21 plays an important role in hypertension	ENCORI
ENSG00000153187	HNRNPU	protein_coding	MIMAT0000076	hsa-miR-21-5p	miR-21 plays an important role in hypertension	ENCORI
ENSG00000186432	KPNA4	protein_coding	MIMAT0000076	hsa-miR-21-5p	miR-21 plays an important role in hypertension	ENCORI
ENSG00000189266	PNRC2	protein_coding	MIMAT0000076	hsa-miR-21-5p	miR-21 plays an important role in hypertension	ENCORI
ENSG00000197111	PCBP2	protein_coding	MIMAT0000076	hsa-miR-21-5p	miR-21 plays an important role in hypertension	ENCORI
ENSG00000090615	GOLGA3	protein_coding	MIMAT0000082	hsa-miR-26a-5p	The presence of the hepatocyte's ballooning degeneration in the liver biopsy correlated positively with pri-miR-26a-1	ENCORI
ENSG00000099364	FBXL19	protein_coding	MIMAT0000082	hsa-miR-26a-5p	The presence of the hepatocyte's ballooning degeneration in the liver biopsy correlated positively with pri-miR-26a-1	ENCORI
ENSG00000100393	EP300	protein_coding	MIMAT0000082	hsa-miR-26a-5p	The presence of the hepatocyte's ballooning degeneration in the liver biopsy correlated positively with pri-miR-26a-1	ENCORI
ENSG00000108953	YWHAE	protein_coding	MIMAT0000082	hsa-miR-26a-5p	The presence of the hepatocyte's ballooning degeneration in the liver biopsy correlated positively with pri-miR-26a-1	ENCORI
ENSG00000109685	NSD2	protein_coding	MIMAT0000082	hsa-miR-26a-5p	The presence of the hepatocyte's ballooning degeneration in the liver biopsy correlated positively with pri-miR-26a-1	ENCORI
ENSG00000109971	HSPA8	protein_coding	MIMAT0000082	hsa-miR-26a-5p	The presence of the hepatocyte's ballooning degeneration in the liver biopsy correlated positively with pri-miR-26a-1	ENCORI
ENSG00000110172	CHORDC1	protein_coding	MIMAT0000082	hsa-miR-26a-5p	The presence of the hepatocyte's ballooning degeneration in the liver biopsy correlated positively with pri-miR-26a-1	ENCORI
ENSG00000111229	ARPC3	protein_coding	MIMAT0000082	hsa-miR-26a-5p	The presence of the hepatocyte's ballooning degeneration in the liver biopsy correlated positively with pri-miR-26a-1	ENCORI
ENSG00000112245	PTP4A1	protein_coding	MIMAT0000082	hsa-miR-26a-5p	The presence of the hepatocyte's ballooning degeneration in the liver biopsy correlated positively with pri-miR-26a-1	ENCORI
ENSG00000117632	STMN1	protein_coding	MIMAT0000082	hsa-miR-26a-5p	The presence of the hepatocyte's ballooning degeneration in the liver biopsy correlated positively with pri-miR-26a-1	ENCORI
ENSG00000117906	RCN2	protein_coding	MIMAT0000082	hsa-miR-26a-5p	The presence of the hepatocyte's ballooning degeneration in the liver biopsy correlated positively with pri-miR-26a-1	ENCORI
ENSG00000121578	B4GALT4	protein_coding	MIMAT0000082	hsa-miR-26a-5p	The presence of the hepatocyte's ballooning degeneration in the liver biopsy correlated positively with pri-miR-26a-1	ENCORI
ENSG00000130635	COL5A1	protein_coding	MIMAT0000082	hsa-miR-26a-5p	The presence of the hepatocyte's ballooning degeneration in the liver biopsy correlated positively with pri-miR-26a-1	ENCORI

ENSG00000141569	TRIM65	protein_coding	MIMAT0000082	hsa-miR-26a-5p	The presence of the hepatocyte's ballooning degeneration in the liver biopsy correlated positively with pri-miR-26a-1	ENCORI
ENSG00000149187	CELF1	protein_coding	MIMAT0000082	hsa-miR-26a-5p	The presence of the hepatocyte's ballooning degeneration in the liver biopsy correlated positively with pri-miR-26a-1	ENCORI
ENSG00000168615	ADAM9	protein_coding	MIMAT0000082	hsa-miR-26a-5p	The presence of the hepatocyte's ballooning degeneration in the liver biopsy correlated positively with pri-miR-26a-1	ENCORI
ENSG00000198792	TMEM184B	protein_coding	MIMAT0000082	hsa-miR-26a-5p	The presence of the hepatocyte's ballooning degeneration in the liver biopsy correlated positively with pri-miR-26a-17	ENCORI
ENSG00000044115	CTNNA1	protein_coding	MIMAT0000091	hsa-miR-33a-5p	miR-33a and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000049449	RCN1	protein_coding	MIMAT0000091	hsa-miR-33a-5p	miR-33a and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000062485	CS	protein_coding	MIMAT0000091	hsa-miR-33a-5p	miR-33a and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000109089	CDR2L	protein_coding	MIMAT0000091	hsa-miR-33a-5p	miR-33a and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000109118	PHF12	protein_coding	MIMAT0000091	hsa-miR-33a-5p	miR-33a and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000134294	SLC38A2	protein_coding	MIMAT0000091	hsa-miR-33a-5p	miR-33a and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000156508	EEF1A1	protein_coding	MIMAT0000091	hsa-miR-33a-5p	miR-33a and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000169139	UBE2V2	protein_coding	MIMAT0000091	hsa-miR-33a-5p	miR-33a and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000170633	RNF34	protein_coding	MIMAT0000091	hsa-miR-33a-5p	miR-33a and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000089157	RPLP0	protein_coding	MIMAT0000101	hsa-miR-103a-3p	potentiates insulin resistance	ENCORI
ENSG00000100664	EIF5	protein_coding	MIMAT0000101	hsa-miR-103a-3p	potentiates insulin resistance	ENCORI
ENSG00000103353	UBFD1	protein_coding	MIMAT0000101	hsa-miR-103a-3p	potentiates insulin resistance	ENCORI
ENSG00000109046	WSB1	protein_coding	MIMAT0000101	hsa-miR-103a-3p	potentiates insulin resistance	ENCORI
ENSG00000116396	KCNC4	protein_coding	MIMAT0000101	hsa-miR-103a-3p	potentiates insulin resistance	ENCORI
ENSG00000116649	SRM	protein_coding	MIMAT0000101	hsa-miR-103a-3p	potentiates insulin resistance	ENCORI
ENSG00000122566	HNRNPA2B1	protein_coding	MIMAT0000101	hsa-miR-103a-3p	potentiates insulin resistance	ENCORI
ENSG00000135968	GCC2	protein_coding	MIMAT0000101	hsa-miR-103a-3p	potentiates insulin resistance	ENCORI
ENSG00000139146	SINHCAF	protein_coding	MIMAT0000101	hsa-miR-103a-3p	potentiates insulin resistance	ENCORI
ENSG00000141279	NPEPPS	protein_coding	MIMAT0000101	hsa-miR-103a-3p	potentiates insulin resistance	ENCORI
ENSG00000143614	GATAD2B	protein_coding	MIMAT0000101	hsa-miR-103a-3p	potentiates insulin resistance	ENCORI
ENSG00000149136	SSRP1	protein_coding	MIMAT0000101	hsa-miR-103a-3p	potentiates insulin resistance	ENCORI

ENSG00000158669	GPAT4	protein_coding	MIMAT0000101	hsa-miR-103a-3p	potentiates insulin resistance	ENCORI
ENSG00000162664	ZNF326	protein_coding	MIMAT0000101	hsa-miR-103a-3p	potentiates insulin resistance	ENCORI
ENSG00000166508	MCM7	protein_coding	MIMAT0000101	hsa-miR-103a-3p	potentiates insulin resistance	ENCORI
ENSG00000167552	TUBA1A	protein_coding	MIMAT0000101	hsa-miR-103a-3p	potentiates insulin resistance	ENCORI
ENSG00000169718	DUS1L	protein_coding	MIMAT0000101	hsa-miR-103a-3p	potentiates insulin resistance	ENCORI
ENSG00000184205	TSPYL2	protein_coding	MIMAT0000101	hsa-miR-103a-3p	potentiates insulin resistance	ENCORI
ENSG00000060237	WNK1	protein_coding	MIMAT0000222	hsa-miR-192-5p	a novel controller of adipocyte differentiation and lipid homeostasis	ENCORI
ENSG00000072210	ALDH3A2	protein_coding	MIMAT0000222	hsa-miR-192-5p	a novel controller of adipocyte differentiation and lipid homeostasis	ENCORI
ENSG00000099194	SCD	protein_coding	MIMAT0000222	hsa-miR-192-5p	a novel controller of adipocyte differentiation and lipid homeostasis	ENCORI
ENSG00000110367	DDX6	protein_coding	MIMAT0000222	hsa-miR-192-5p	a novel controller of adipocyte differentiation and lipid homeostasis	ENCORI
ENSG00000113456	RAD1	protein_coding	MIMAT0000222	hsa-miR-192-5p	a novel controller of adipocyte differentiation and lipid homeostasis	ENCORI
ENSG00000113575	PPP2CA	protein_coding	MIMAT0000222	hsa-miR-192-5p	a novel controller of adipocyte differentiation and lipid homeostasis	ENCORI
ENSG00000169925	BRD3	protein_coding	MIMAT0000222	hsa-miR-192-5p	a novel controller of adipocyte differentiation and lipid homeostasis	ENCORI
ENSG00000006007	GDE1	protein_coding	MIMAT0000250	hsa-miR-139-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-139-5p	ENCORI
ENSG00000082898	XPO1	protein_coding	MIMAT0000250	hsa-miR-139-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-139-5p	ENCORI
ENSG00000104341	LAPTM4B	protein_coding	MIMAT0000250	hsa-miR-139-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-139-5p	ENCORI
ENSG00000129422	MTUS1	protein_coding	MIMAT0000250	hsa-miR-139-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-139-5p	ENCORI
ENSG00000150753	CCT5	protein_coding	MIMAT0000250	hsa-miR-139-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-139-5p	ENCORI
ENSG00000151208	DLG5	protein_coding	MIMAT0000250	hsa-miR-139-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-139-5p	ENCORI
ENSG00000152601	MBNL1	protein_coding	MIMAT0000250	hsa-miR-139-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-139-5p	ENCORI
ENSG00000159596	TMEM69	protein_coding	MIMAT0000250	hsa-miR-139-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-139-5p	ENCORI
ENSG00000164649	CDCA7L	protein_coding	MIMAT0000250	hsa-miR-139-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-139-5p	ENCORI

ENSG00000169504	CLIC4	protein_coding	MIMAT0000250	hsa-miR-139-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-139-5p	ENCORI
ENSG00000170035	UBE2E3	protein_coding	MIMAT0000250	hsa-miR-139-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-139-5p	ENCORI
ENSG00000173141	MRPL57	protein_coding	MIMAT0000250	hsa-miR-139-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-139-5p	ENCORI
ENSG00000174197	MGA	protein_coding	MIMAT0000250	hsa-miR-139-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-139-5p	ENCORI
ENSG00000186468	RPS23	protein_coding	MIMAT0000250	hsa-miR-139-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-139-5p	ENCORI
ENSG00000198876	DCAF12	protein_coding	MIMAT0000250	hsa-miR-139-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-139-5p	ENCORI
ENSG00000009307	CSDE1	protein_coding	MIMAT0000252	hsa-miR-7-5p	Histologic NASH correlated positively with the expression levels of pri-miR-7-1	ENCORI
ENSG00000025800	KPNA6	protein_coding	MIMAT0000252	hsa-miR-7-5p	Histologic NASH correlated positively with the expression levels of pri-miR-7-2	ENCORI
ENSG00000066117	SMARCD1	protein_coding	MIMAT0000252	hsa-miR-7-5p	Histologic NASH correlated positively with the expression levels of pri-miR-7-3	ENCORI
ENSG00000070087	PFN2	protein_coding	MIMAT0000252	hsa-miR-7-5p	Histologic NASH correlated positively with the expression levels of pri-miR-7-4	ENCORI
ENSG00000102908	NFAT5	protein_coding	MIMAT0000252	hsa-miR-7-5p	Histologic NASH correlated positively with the expression levels of pri-miR-7-5	ENCORI
ENSG00000127483	HP1BP3	protein_coding	MIMAT0000252	hsa-miR-7-5p	Histologic NASH correlated positively with the expression levels of pri-miR-7-6	ENCORI
ENSG00000128595	CALU	protein_coding	MIMAT0000252	hsa-miR-7-5p	Histologic NASH correlated positively with the expression levels of pri-miR-7-7	ENCORI
ENSG00000131467	PSME3	protein_coding	MIMAT0000252	hsa-miR-7-5p	Histologic NASH correlated positively with the expression levels of pri-miR-7-8	ENCORI
ENSG00000132589	FLOT2	protein_coding	MIMAT0000252	hsa-miR-7-5p	Histologic NASH correlated positively with the expression levels of pri-miR-7-9	ENCORI
ENSG00000147162	OGT	protein_coding	MIMAT0000252	hsa-miR-7-5p	Histologic NASH correlated positively with the expression levels of pri-miR-7-10	ENCORI
ENSG00000160014	CALM3	protein_coding	MIMAT0000252	hsa-miR-7-5p	Histologic NASH correlated positively with the expression levels of pri-miR-7-11	ENCORI
ENSG00000169221	TBC1D10B	protein_coding	MIMAT0000252	hsa-miR-7-5p	Histologic NASH correlated positively with the expression levels of pri-miR-7-12	ENCORI
ENSG00000176542	USF3	protein_coding	MIMAT0000252	hsa-miR-7-5p	Histologic NASH correlated positively with the expression levels of pri-miR-7-13	ENCORI

ENSG00000176788	BASP1	protein_coding	MIMAT0000252	hsa-miR-7-5p	Histologic NASH correlated positively with the expression levels of pri-miR-7-14	ENCORI
ENSG00000178980	SELENOW	protein_coding	MIMAT0000252	hsa-miR-7-5p	Histologic NASH correlated positively with the expression levels of pri-miR-7-15	ENCORI
ENSG00000179051	RCC2	protein_coding	MIMAT0000252	hsa-miR-7-5p	Histologic NASH correlated positively with the expression levels of pri-miR-7-16	ENCORI
ENSG00000228474	OST4	protein_coding	MIMAT0000252	hsa-miR-7-5p	Histologic NASH correlated positively with the expression levels of pri-miR-7-17	ENCORI
ENSG00000071626	DAZAP1	protein_coding	MIMAT0000253	hsa-miR-10a-5p	ameliorated the premature aging phenotype	ENCORI
ENSG00000108669	CYTH1	protein_coding	MIMAT0000253	hsa-miR-10a-5p	ameliorated the premature aging phenotype	ENCORI
ENSG00000184009	ACTG1	protein_coding	MIMAT0000253	hsa-miR-10a-5p	ameliorated the premature aging phenotype	ENCORI
ENSG00000067715	SYT1	protein_coding	MIMAT0000255	hsa-miR-34a-5p	associates with mitochondria dynamics dysfunction in human NAFLD	ENCORI
ENSG00000106144	CASP2	protein_coding	MIMAT0000255	hsa-miR-34a-5p	associates with mitochondria dynamics dysfunction in human NAFLD	ENCORI
ENSG00000114988	LMAN2L	protein_coding	MIMAT0000255	hsa-miR-34a-5p	associates with mitochondria dynamics dysfunction in human NAFLD	ENCORI
ENSG00000140688	C16orf58	protein_coding	MIMAT0000255	hsa-miR-34a-5p	associates with mitochondria dynamics dysfunction in human NAFLD	ENCORI
ENSG00000144713	RPL32	protein_coding	MIMAT0000255	hsa-miR-34a-5p	associates with mitochondria dynamics dysfunction in human NAFLD	ENCORI
ENSG00000149547	EI24	protein_coding	MIMAT0000255	hsa-miR-34a-5p	associates with mitochondria dynamics dysfunction in human NAFLD	ENCORI
ENSG00000173898	SPTBN2	protein_coding	MIMAT0000255	hsa-miR-34a-5p	associates with mitochondria dynamics dysfunction in human NAFLD	ENCORI
ENSG00000177303	CASKIN2	protein_coding	MIMAT0000255	hsa-miR-34a-5p	associates with mitochondria dynamics dysfunction in human NAFLD	ENCORI
ENSG00000185414	MRPL30	protein_coding	MIMAT0000255	hsa-miR-34a-5p	associates with mitochondria dynamics dysfunction in human NAFLD	ENCORI
ENSG00000069275	NUCKS1	protein_coding	MIMAT0000256	hsa-miR-181a-5p	Decreased miR-181a expression in monocytes of obese patients is associated with the occurrence of metabolic syndrome and coronary artery disease	ENCORI
ENSG00000089006	SNX5	protein_coding	MIMAT0000256	hsa-miR-181a-5p	Decreased miR-181a expression in monocytes of obese patients is associated with the occurrence of metabolic syndrome and coronary artery disease	ENCORI
ENSG00000106070	GRB10	protein_coding	MIMAT0000256	hsa-miR-181a-5p	Decreased miR-181a expression in monocytes of obese patients is associated with the occurrence of metabolic syndrome and coronary artery disease	ENCORI

ENSG00000118705	RPN2	protein_coding	MIMAT0000256	hsa-miR-181a-5p	Decreased miR-181a expression in monocytes of obese patients is associated with the occurrence of metabolic syndrome and coronary artery disease	ENCORI
ENSG00000123297	TSFM	protein_coding	MIMAT0000256	hsa-miR-181a-5p	Decreased miR-181a expression in monocytes of obese patients is associated with the occurrence of metabolic syndrome and coronary artery disease	ENCORI
ENSG00000129422	MTUS1	protein_coding	MIMAT0000256	hsa-miR-181a-5p	Decreased miR-181a expression in monocytes of obese patients is associated with the occurrence of metabolic syndrome and coronary artery disease	ENCORI
ENSG00000134287	ARF3	protein_coding	MIMAT0000256	hsa-miR-181a-5p	Decreased miR-181a expression in monocytes of obese patients is associated with the occurrence of metabolic syndrome and coronary artery disease	ENCORI
ENSG00000134986	NREP	protein_coding	MIMAT0000256	hsa-miR-181a-5p	Decreased miR-181a expression in monocytes of obese patients is associated with the occurrence of metabolic syndrome and coronary artery disease	ENCORI
ENSG00000151491	EPS8	protein_coding	MIMAT0000256	hsa-miR-181a-5p	Decreased miR-181a expression in monocytes of obese patients is associated with the occurrence of metabolic syndrome and coronary artery disease	ENCORI
ENSG00000154734	ADAMTS1	protein_coding	MIMAT0000256	hsa-miR-181a-5p	Decreased miR-181a expression in monocytes of obese patients is associated with the occurrence of metabolic syndrome and coronary artery disease	ENCORI
ENSG00000164924	YWHAZ	protein_coding	MIMAT0000256	hsa-miR-181a-5p	Decreased miR-181a expression in monocytes of obese patients is associated with the occurrence of metabolic syndrome and coronary artery disease	ENCORI
ENSG00000170027	YWHAG	protein_coding	MIMAT0000256	hsa-miR-181a-5p	Decreased miR-181a expression in monocytes of obese patients is associated with the occurrence of metabolic syndrome and coronary artery disease	ENCORI
ENSG00000184557	SOCS3	protein_coding	MIMAT0000256	hsa-miR-181a-5p	Decreased miR-181a expression in monocytes of obese patients is associated with the occurrence of metabolic syndrome and coronary artery disease	ENCORI
ENSG00000196313	POM121	protein_coding	MIMAT0000256	hsa-miR-181a-5p	Decreased miR-181a expression in monocytes of obese patients is associated with the occurrence of metabolic syndrome and coronary artery disease	ENCORI
ENSG00000196387	ZNF140	protein_coding	MIMAT0000256	hsa-miR-181a-5p	Decreased miR-181a expression in monocytes of obese patients is associated with the occurrence of metabolic syndrome and coronary artery disease	ENCORI
ENSG00000198380	GFPT1	protein_coding	MIMAT0000256	hsa-miR-181a-5p	Decreased miR-181a expression in monocytes of obese patients is associated with the occurrence of metabolic syndrome and coronary artery disease	ENCORI

ENSG00000272391	POM121C	protein_coding	MIMAT0000256	hsa-miR-181a-5p	Decreased miR-181a expression in monocytes of obese patients is associated with the occurrence of metabolic syndrome and coronary artery disease	ENCORI
ENSG00000035141	FAM136A	protein_coding	MIMAT0000266	hsa-miR-205-5p	miR-205 regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000058673	ZC3H11A	protein_coding	MIMAT0000266	hsa-miR-205-5p	miR-205 regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000077147	TM9SF3	protein_coding	MIMAT0000266	hsa-miR-205-5p	miR-205 regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000086061	DNAJA1	protein_coding	MIMAT0000266	hsa-miR-205-5p	miR-205 regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000095739	BAMBI	protein_coding	MIMAT0000266	hsa-miR-205-5p	miR-205 regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000096746	HNRNPH3	protein_coding	MIMAT0000266	hsa-miR-205-5p	miR-205 regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000100941	PNN	protein_coding	MIMAT0000266	hsa-miR-205-5p	miR-205 regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000108654	DDX5	protein_coding	MIMAT0000266	hsa-miR-205-5p	miR-205 regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000112242	E2F3	protein_coding	MIMAT0000266	hsa-miR-205-5p	miR-205 regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000113013	HSPA9	protein_coding	MIMAT0000266	hsa-miR-205-5p	miR-205 regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000121578	B4GALT4	protein_coding	MIMAT0000266	hsa-miR-205-5p	miR-205 regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000127022	CANX	protein_coding	MIMAT0000266	hsa-miR-205-5p	miR-205 regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000134250	NOTCH2	protein_coding	MIMAT0000266	hsa-miR-205-5p	miR-205 regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000138758	#####	protein_coding	MIMAT0000266	hsa-miR-205-5p	miR-205 regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000170584	NUDCD2	protein_coding	MIMAT0000266	hsa-miR-205-5p	miR-205 regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000257315	ZBED6	protein_coding	MIMAT0000266	hsa-miR-205-5p	miR-205 regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000264343	NOTCH2NL	protein_coding	MIMAT0000266	hsa-miR-205-5p	miR-205 regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000134046	MBD2	protein_coding	MIMAT0000278	hsa-miR-221-3p	regulates Angiopoietin-like 8 expression in adipocytes	ENCORI
ENSG00000139496	NUP58	protein_coding	MIMAT0000278	hsa-miR-221-3p	regulates Angiopoietin-like 8 expression in adipocytes	ENCORI

ENSG00000142871	CYR61	protein_coding	MIMAT0000278	hsa-miR-221-3p	regulates Angiopoietin-like 8 expression in adipocytes	ENCORI
ENSG00000161642	ZNF385A	protein_coding	MIMAT0000278	hsa-miR-221-3p	regulates Angiopoietin-like 8 expression in adipocytes	ENCORI
ENSG00000170027	YWHAG	protein_coding	MIMAT0000278	hsa-miR-221-3p	regulates Angiopoietin-like 8 expression in adipocytes	ENCORI
ENSG00000170035	UBE2E3	protein_coding	MIMAT0000278	hsa-miR-221-3p	regulates Angiopoietin-like 8 expression in adipocytes	ENCORI
ENSG00000205937	RNPS1	protein_coding	MIMAT0000278	hsa-miR-221-3p	regulates Angiopoietin-like 8 expression in adipocytes	ENCORI
ENSG00000277443	MARCKS	protein_coding	MIMAT0000278	hsa-miR-221-3p	regulates Angiopoietin-like 8 expression in adipocytes	ENCORI
ENSG00000065613	SLK	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000072401	UBE2D1	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000105835	NAMPT	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000107036	RIC1	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000113580	NR3C1	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000115216	NRBP1	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000123933	MXD4	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000124783	SSR1	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000125814	NAPB	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000135829	DHX9	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000137504	CREBZF	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000138434	SSFA2	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000138443	ABI2	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000139737	SLAIN1	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000161547	SRSF2	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000162613	FUBP1	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI

ENSG00000164442	CITED2	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000165424	ZCCHC24	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000166734	CASC4	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000166803	PCLAF	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000171033	PKIA	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000182670	TTC3	protein_coding	MIMAT0000318	hsa-miR-200b-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000006125	AP2B1	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000032444	PNPLA6	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000058673	ZC3H11A	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000101152	DNAJC5	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000109046	WSB1	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000116396	KCNC4	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000116754	SRSF11	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000119537	KDSR	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000125733	TRIP10	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000133612	AGAP3	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000138443	ABI2	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000139146	SINHCAF	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000143207	COP1	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000146830	GIGYF1	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000149136	SSRP1	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000157954	WIPI2	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000158669	GPAT4	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000160703	NLRX1	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000167552	TUBA1A	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000168807	SNTB2	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000173545	ZNF622	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000173821	RNF213	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000173898	SPTBN2	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000184205	TSPYL2	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000198718	TOGARAM1	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI

ENSG00000241878	PISD	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000257315	ZBED6	protein_coding	MIMAT0000417	hsa-miR-15b-5p	was associated with a decrease in insulin resistance	ENCORI
ENSG00000012660	ELOVL5	protein_coding	MIMAT0000420	hsa-miR-30b-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-30b-5p	ENCORI
ENSG00000114353	GNAI2	protein_coding	MIMAT0000420	hsa-miR-30b-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-30b-5p	ENCORI
ENSG00000115875	SRSF7	protein_coding	MIMAT0000420	hsa-miR-30b-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-30b-5p	ENCORI
ENSG00000116017	ARID3A	protein_coding	MIMAT0000420	hsa-miR-30b-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-30b-5p	ENCORI
ENSG00000122482	ZNF644	protein_coding	MIMAT0000420	hsa-miR-30b-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-30b-5p	ENCORI
ENSG00000124214	STAU1	protein_coding	MIMAT0000420	hsa-miR-30b-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-30b-5p	ENCORI
ENSG00000146112	PPP1R18	protein_coding	MIMAT0000420	hsa-miR-30b-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-30b-5p	ENCORI
ENSG00000162923	WDR26	protein_coding	MIMAT0000420	hsa-miR-30b-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-30b-5p	ENCORI
ENSG00000166025	AMOTL1	protein_coding	MIMAT0000420	hsa-miR-30b-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-30b-5p	ENCORI
ENSG00000168615	ADAM9	protein_coding	MIMAT0000420	hsa-miR-30b-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-30b-5p	ENCORI
ENSG00000169756	LIMS1	protein_coding	MIMAT0000420	hsa-miR-30b-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-30b-5p	ENCORI
ENSG00000171223	JUNB	protein_coding	MIMAT0000420	hsa-miR-30b-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-30b-5p	ENCORI
ENSG00000171865	RNASEH1	protein_coding	MIMAT0000420	hsa-miR-30b-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-30b-5p	ENCORI
ENSG00000277443	MARCKS	protein_coding	MIMAT0000420	hsa-miR-30b-5p	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-30b-5p	ENCORI
ENSG00000067225	PKM	protein_coding	MIMAT0000421	hsa-miR-122-5p	Decreased miR-122-5p in liver was associated with impaired FA usage	ENCORI
ENSG00000085644	ZNF213	protein_coding	MIMAT0000421	hsa-miR-122-5p	Decreased miR-122-5p in liver was associated with impaired FA usage	ENCORI
ENSG00000118454	ANKRD13C	protein_coding	MIMAT0000421	hsa-miR-122-5p	Decreased miR-122-5p in liver was associated with impaired FA usage	ENCORI
ENSG00000125970	RALY	protein_coding	MIMAT0000421	hsa-miR-122-5p	Decreased miR-122-5p in liver was associated with impaired FA usage	ENCORI

ENSG00000140575	IQGAP1	protein_coding	MIMAT0000421	hsa-miR-122-5p	Decreased miR-122-5p in liver was associated with impaired FA usage	ENCORI
ENSG00000147065	MSN	protein_coding	MIMAT0000421	hsa-miR-122-5p	Decreased miR-122-5p in liver was associated with impaired FA usage	ENCORI
ENSG00000147140	NONO	protein_coding	MIMAT0000421	hsa-miR-122-5p	Decreased miR-122-5p in liver was associated with impaired FA usage	ENCORI
ENSG00000149925	ALDOA	protein_coding	MIMAT0000421	hsa-miR-122-5p	Decreased miR-122-5p in liver was associated with impaired FA usage	ENCORI
ENSG00000175826	CTDNEP1	protein_coding	MIMAT0000421	hsa-miR-122-5p	Decreased miR-122-5p in liver was associated with impaired FA usage	ENCORI
ENSG00000285043	ALDOA	protein_coding	MIMAT0000421	hsa-miR-122-5p	Decreased miR-122-5p in liver was associated with impaired FA usage	ENCORI
ENSG00000071127	WDR1	protein_coding	MIMAT0000423	hsa-miR-125b-5p	The expression profile of pri-miR-125b-2 correlated positively with body mass index	ENCORI
ENSG00000138867	GUCD1	protein_coding	MIMAT0000423	hsa-miR-125b-5p	The expression profile of pri-miR-125b-2 correlated positively with body mass index	ENCORI
ENSG00000143575	HAX1	protein_coding	MIMAT0000423	hsa-miR-125b-5p	The expression profile of pri-miR-125b-2 correlated positively with body mass index	ENCORI
ENSG00000144120	TMEM177	protein_coding	MIMAT0000423	hsa-miR-125b-5p	The expression profile of pri-miR-125b-2 correlated positively with body mass index	ENCORI
ENSG00000156521	TYSND1	protein_coding	MIMAT0000423	hsa-miR-125b-5p	The expression profile of pri-miR-125b-2 correlated positively with body mass index	ENCORI
ENSG00000156709	AIFM1	protein_coding	MIMAT0000423	hsa-miR-125b-5p	The expression profile of pri-miR-125b-2 correlated positively with body mass index	ENCORI
ENSG00000167566	NCKAP5L	protein_coding	MIMAT0000423	hsa-miR-125b-5p	The expression profile of pri-miR-125b-2 correlated positively with body mass index	ENCORI
ENSG00000172531	PPP1CA	protein_coding	MIMAT0000423	hsa-miR-125b-5p	The expression profile of pri-miR-125b-2 correlated positively with body mass index	ENCORI
ENSG00000100575	TIMM9	protein_coding	MIMAT0000426	hsa-miR-132-3p	The expression of mir-132 is positively correlated with the severity of diabetes	ENCORI
ENSG00000104695	PPP2CB	protein_coding	MIMAT0000426	hsa-miR-132-3p	The expression of mir-132 is positively correlated with the severity of diabetes	ENCORI
ENSG00000113387	SUB1	protein_coding	MIMAT0000426	hsa-miR-132-3p	The expression of mir-132 is positively correlated with the severity of diabetes	ENCORI
ENSG00000120738	EGR1	protein_coding	MIMAT0000426	hsa-miR-132-3p	The expression of mir-132 is positively correlated with the severity of diabetes	ENCORI
ENSG00000126777	KTN1	protein_coding	MIMAT0000426	hsa-miR-132-3p	The expression of mir-132 is positively correlated with the severity of diabetes	ENCORI

ENSG00000146830	GIGYF1	protein_coding	MIMAT0000426	hsa-miR-132-3p	The expression of mir-132 is positively correlated with the severity of diabetes	ENCORI
ENSG00000151893	CACUL1	protein_coding	MIMAT0000426	hsa-miR-132-3p	The expression of mir-132 is positively correlated with the severity of diabetes	ENCORI
ENSG00000164754	RAD21	protein_coding	MIMAT0000426	hsa-miR-132-3p	The expression of mir-132 is positively correlated with the severity of diabetes	ENCORI
ENSG00000165389	SPTSSA	protein_coding	MIMAT0000426	hsa-miR-132-3p	The expression of mir-132 is positively correlated with the severity of diabetes	ENCORI
ENSG00000169756	LIMS1	protein_coding	MIMAT0000426	hsa-miR-132-3p	The expression of mir-132 is positively correlated with the severity of diabetes	ENCORI
ENSG00000181467	RAP2B	protein_coding	MIMAT0000426	hsa-miR-132-3p	The expression of mir-132 is positively correlated with the severity of diabetes	ENCORI
ENSG00000184575	XPOT	protein_coding	MIMAT0000426	hsa-miR-132-3p	The expression of mir-132 is positively correlated with the severity of diabetes	ENCORI
ENSG00000198176	TFDP1	protein_coding	MIMAT0000426	hsa-miR-132-3p	The expression of mir-132 is positively correlated with the severity of diabetes	ENCORI
ENSG00000239306	RBM14	protein_coding	MIMAT0000426	hsa-miR-132-3p	The expression of mir-132 is positively correlated with the severity of diabetes	ENCORI
ENSG00000025796	SEC63	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000054267	ARID4B	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000067560	RHOA	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000073417	PDE8A	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000082153	BZW1	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000109046	WSB1	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000112245	PTP4A1	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000115414	FN1	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000115540	MOB4	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000117519	CNN3	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI

ENSG00000117523	PRRC2C	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000117713	ARID1A	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000120733	KDM3B	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000126945	HNRNPH2	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000130749	ZC3H4	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000133731	IMPA1	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000135316	SYNCRIP	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000136521	NDUFB5	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000139793	MBNL2	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000143179	UCK2	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000150347	ARID5B	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000150995	ITPR1	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000165525	NEMF	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000166444	ST5	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000166681	BEX3	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000166747	AP1G1	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000177383	MAGEF1	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000177565	TBL1XR1	protein_coding	MIMAT0000436	hsa-miR-144-3p	miR-144 and their target gene ABCA1 may contribute to the pathogenesis of NASH in morbidly obese subjects	ENCORI
ENSG00000011454	RABGAP1	protein_coding	MIMAT0000449	hsa-miR-146a-5p	causing lipoapoptosis of pancreatic islet cells, resulting in insulin deficiency and increased miR-146b-5p was associated with FABP4 and decreased glucose metabolism and FA mobilization	ENCORI

ENSG00000022267	FHL1	protein_coding	MIMAT0000449	hsa-miR-146a-5p	causing lipoapoptosis of pancreatic islet cells, resulting in insulin deficiency and increased miR-146b-5p was associated with FABP4 and decreased glucose metabolism and FA mobilization	ENCORI
ENSG00000025800	KPNA6	protein_coding	MIMAT0000449	hsa-miR-146a-5p	causing lipoapoptosis of pancreatic islet cells, resulting in insulin deficiency and increased miR-146b-5p was associated with FABP4 and decreased glucose metabolism and FA mobilization	ENCORI
ENSG00000143862	ARL8A	protein_coding	MIMAT0000449	hsa-miR-146a-5p	causing lipoapoptosis of pancreatic islet cells, resulting in insulin deficiency and increased miR-146b-5p was associated with FABP4 and decreased glucose metabolism and FA mobilization	ENCORI
ENSG00000239672	NME1	protein_coding	MIMAT0000449	hsa-miR-146a-5p	causing lipoapoptosis of pancreatic islet cells, resulting in insulin deficiency and increased miR-146b-5p was associated with FABP4 and decreased glucose metabolism and FA mobilization	ENCORI
ENSG00000048828	FAM120A	protein_coding	MIMAT0000646	hsa-miR-155-5p	loss of miR-155 increases intake of an obesogenic diet	ENCORI
ENSG00000071539	TRIP13	protein_coding	MIMAT0000646	hsa-miR-155-5p	loss of miR-155 increases intake of an obesogenic diet	ENCORI
ENSG00000117525	F3	protein_coding	MIMAT0000646	hsa-miR-155-5p	loss of miR-155 increases intake of an obesogenic diet	ENCORI
ENSG00000117906	RCN2	protein_coding	MIMAT0000646	hsa-miR-155-5p	loss of miR-155 increases intake of an obesogenic diet	ENCORI
ENSG00000137831	UACA	protein_coding	MIMAT0000646	hsa-miR-155-5p	loss of miR-155 increases intake of an obesogenic diet	ENCORI
ENSG00000168264	IRF2BP2	protein_coding	MIMAT0000646	hsa-miR-155-5p	loss of miR-155 increases intake of an obesogenic diet	ENCORI
ENSG00000065150	IPO5	protein_coding	MIMAT0000682	hsa-miR-200a-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000083312	TNPO1	protein_coding	MIMAT0000682	hsa-miR-200a-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000099364	FBXL19	protein_coding	MIMAT0000682	hsa-miR-200a-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000105887	MTPN	protein_coding	MIMAT0000682	hsa-miR-200a-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000107372	ZFAND5	protein_coding	MIMAT0000682	hsa-miR-200a-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000112245	PTP4A1	protein_coding	MIMAT0000682	hsa-miR-200a-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000112972	HMGCS1	protein_coding	MIMAT0000682	hsa-miR-200a-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000113328	CCNG1	protein_coding	MIMAT0000682	hsa-miR-200a-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000136521	NDUFB5	protein_coding	MIMAT0000682	hsa-miR-200a-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI

ENSG00000144566	RAB5A	protein_coding	MIMAT0000682	hsa-miR-200a-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000152102	FAM168B	protein_coding	MIMAT0000682	hsa-miR-200a-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000153936	HS2ST1	protein_coding	MIMAT0000682	hsa-miR-200a-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000162704	ARPC5	protein_coding	MIMAT0000682	hsa-miR-200a-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000163539	CLASP2	protein_coding	MIMAT0000682	hsa-miR-200a-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000163714	U2SURP	protein_coding	MIMAT0000682	hsa-miR-200a-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000167615	LENG8	protein_coding	MIMAT0000682	hsa-miR-200a-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000185722	ANKFY1	protein_coding	MIMAT0000682	hsa-miR-200a-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000187109	NAP1L1	protein_coding	MIMAT0000682	hsa-miR-200a-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000239672	NME1	protein_coding	MIMAT0000682	hsa-miR-200a-3p	The miR-200 family regulate epithelial to mesenchymal transition by targeting ZEB1 and SIP1	ENCORI
ENSG00000003056	M6PR	protein_coding	MIMAT0000688	hsa-miR-301a-3p	miR-301a-3p increased with disease progression	ENCORI
ENSG00000032444	PNPLA6	protein_coding	MIMAT0000688	hsa-miR-301a-3p	miR-301a-3p increased with disease progression	ENCORI
ENSG00000110367	DDX6	protein_coding	MIMAT0000688	hsa-miR-301a-3p	miR-301a-3p increased with disease progression	ENCORI
ENSG00000112531	QKI	protein_coding	MIMAT0000688	hsa-miR-301a-3p	miR-301a-3p increased with disease progression	ENCORI
ENSG00000118454	ANKRD13C	protein_coding	MIMAT0000688	hsa-miR-301a-3p	miR-301a-3p increased with disease progression	ENCORI
ENSG00000129562	DAD1	protein_coding	MIMAT0000688	hsa-miR-301a-3p	miR-301a-3p increased with disease progression	ENCORI
ENSG00000130164	LDLR	protein_coding	MIMAT0000688	hsa-miR-301a-3p	miR-301a-3p increased with disease progression	ENCORI
ENSG00000144566	RAB5A	protein_coding	MIMAT0000688	hsa-miR-301a-3p	miR-301a-3p increased with disease progression	ENCORI
ENSG00000160785	SLC25A44	protein_coding	MIMAT0000688	hsa-miR-301a-3p	miR-301a-3p increased with disease progression	ENCORI
ENSG00000198160	MIER1	protein_coding	MIMAT0000688	hsa-miR-301a-3p	miR-301a-3p increased with disease progression	ENCORI
ENSG00000003056	M6PR	protein_coding	MIMAT0000691	hsa-miR-130b-3p	The expression of mir-130 is positively correlated with the severity of diabetes	ENCORI
ENSG00000032444	PNPLA6	protein_coding	MIMAT0000691	hsa-miR-130b-3p	The expression of mir-130 is positively correlated with the severity of diabetes	ENCORI
ENSG00000110367	DDX6	protein_coding	MIMAT0000691	hsa-miR-130b-3p	The expression of mir-130 is positively correlated with the severity of diabetes	ENCORI
ENSG00000112531	QKI	protein_coding	MIMAT0000691	hsa-miR-130b-3p	The expression of mir-130 is positively correlated with the severity of diabetes	ENCORI

ENSG00000118454	ANKRD13C	protein_coding	MIMAT0000691	hsa-miR-130b-3p	The expression of mir-130 is positively correlated with the severity of diabetes	ENCORI
ENSG00000129562	DAD1	protein_coding	MIMAT0000691	hsa-miR-130b-3p	The expression of mir-130 is positively correlated with the severity of diabetes	ENCORI
ENSG00000130164	LDLR	protein_coding	MIMAT0000691	hsa-miR-130b-3p	The expression of mir-130 is positively correlated with the severity of diabetes	ENCORI
ENSG00000144566	RAB5A	protein_coding	MIMAT0000691	hsa-miR-130b-3p	The expression of mir-130 is positively correlated with the severity of diabetes	ENCORI
ENSG00000160785	SLC25A44	protein_coding	MIMAT0000691	hsa-miR-130b-3p	The expression of mir-130 is positively correlated with the severity of diabetes	ENCORI
ENSG00000198160	MIER1	protein_coding	MIMAT0000691	hsa-miR-130b-3p	The expression of mir-130 is positively correlated with the severity of diabetes	ENCORI
ENSG00000065978	YBX1	protein_coding	MIMAT0000728	hsa-miR-375	miR-375 decreased with nonalcoholic fatty liver disease progression	ENCORI
ENSG00000106682	EIF4H	protein_coding	MIMAT0000728	hsa-miR-375	miR-375 decreased with nonalcoholic fatty liver disease progression	ENCORI
ENSG00000108510	MED13	protein_coding	MIMAT0000728	hsa-miR-375	miR-375 decreased with nonalcoholic fatty liver disease progression	ENCORI
ENSG00000111716	LDHB	protein_coding	MIMAT0000728	hsa-miR-375	miR-375 decreased with nonalcoholic fatty liver disease progression	ENCORI
ENSG00000113369	ARRDC3	protein_coding	MIMAT0000728	hsa-miR-375	miR-375 decreased with nonalcoholic fatty liver disease progression	ENCORI
ENSG00000121067	SPOP	protein_coding	MIMAT0000728	hsa-miR-375	miR-375 decreased with nonalcoholic fatty liver disease progression	ENCORI
ENSG00000123983	ACSL3	protein_coding	MIMAT0000728	hsa-miR-375	miR-375 decreased with nonalcoholic fatty liver disease progression	ENCORI
ENSG00000127947	PTPN12	protein_coding	MIMAT0000728	hsa-miR-375	miR-375 decreased with nonalcoholic fatty liver disease progression	ENCORI
ENSG00000139154	AEBP2	protein_coding	MIMAT0000728	hsa-miR-375	miR-375 decreased with nonalcoholic fatty liver disease progression	ENCORI
ENSG00000164985	PSIP1	protein_coding	MIMAT0000728	hsa-miR-375	miR-375 decreased with nonalcoholic fatty liver disease progression	ENCORI
ENSG00000166272	WBP1L	protein_coding	MIMAT0000728	hsa-miR-375	miR-375 decreased with nonalcoholic fatty liver disease progression	ENCORI
ENSG00000032444	PNPLA6	protein_coding	MIMAT0000759	hsa-miR-148b-3p	Increase in muscle miR-148b content might thus participate in the decrease in insulin sensitivity at the whole body level during the transition toward physical inactivity	ENCORI
ENSG00000034510	TMSB10	protein_coding	MIMAT0000759	hsa-miR-148b-3p	Increase in muscle miR-148b content might thus participate in the decrease in insulin sensitivity at the whole body level during the transition toward physical inactivity	ENCORI

ENSG00000064601	CTSA	protein_coding	MIMAT0000759	hsa-miR-148b-3p	Increase in muscle miR-148b content might thus participate in the decrease in insulin sensitivity at the whole body level during the transition toward physical inactivity	ENCORI
ENSG00000087111	PIGS	protein_coding	MIMAT0000759	hsa-miR-148b-3p	Increase in muscle miR-148b content might thus participate in the decrease in insulin sensitivity at the whole body level during the transition toward physical inactivity	ENCORI
ENSG00000100568	VTI1B	protein_coding	MIMAT0000759	hsa-miR-148b-3p	Increase in muscle miR-148b content might thus participate in the decrease in insulin sensitivity at the whole body level during the transition toward physical inactivity	ENCORI
ENSG00000102908	NFAT5	protein_coding	MIMAT0000759	hsa-miR-148b-3p	Increase in muscle miR-148b content might thus participate in the decrease in insulin sensitivity at the whole body level during the transition toward physical inactivity	ENCORI
ENSG00000104064	GABPB1	protein_coding	MIMAT0000759	hsa-miR-148b-3p	Increase in muscle miR-148b content might thus participate in the decrease in insulin sensitivity at the whole body level during the transition toward physical inactivity	ENCORI
ENSG00000110367	DDX6	protein_coding	MIMAT0000759	hsa-miR-148b-3p	Increase in muscle miR-148b content might thus participate in the decrease in insulin sensitivity at the whole body level during the transition toward physical inactivity	ENCORI
ENSG00000111737	RAB35	protein_coding	MIMAT0000759	hsa-miR-148b-3p	Increase in muscle miR-148b content might thus participate in the decrease in insulin sensitivity at the whole body level during the transition toward physical inactivity	ENCORI
ENSG00000112531	QKI	protein_coding	MIMAT0000759	hsa-miR-148b-3p	Increase in muscle miR-148b content might thus participate in the decrease in insulin sensitivity at the whole body level during the transition toward physical inactivity	ENCORI
ENSG00000116717	GADD45A	protein_coding	MIMAT0000759	hsa-miR-148b-3p	Increase in muscle miR-148b content might thus participate in the decrease in insulin sensitivity at the whole body level during the transition toward physical inactivity	ENCORI
ENSG00000136854	STXBP1	protein_coding	MIMAT0000759	hsa-miR-148b-3p	Increase in muscle miR-148b content might thus participate in the decrease in insulin sensitivity at the whole body level during the transition toward physical inactivity	ENCORI
ENSG00000145860	RNF145	protein_coding	MIMAT0000759	hsa-miR-148b-3p	Increase in muscle miR-148b content might thus participate in the decrease in insulin sensitivity at the whole body level during the transition toward physical inactivity	ENCORI
ENSG00000148719	DNAJB12	protein_coding	MIMAT0000759	hsa-miR-148b-3p	Increase in muscle miR-148b content might thus participate in the decrease in insulin sensitivity at the whole body level during the transition toward physical inactivity	ENCORI
ENSG00000160785	SLC25A44	protein_coding	MIMAT0000759	hsa-miR-148b-3p	Increase in muscle miR-148b content might thus participate in the decrease in insulin sensitivity at the whole body level during the transition toward physical inactivity	ENCORI

ENSG00000170471	RALGAPB	protein_coding	MIMAT0000759	hsa-miR-148b-3p	Increase in muscle miR-148b content might thus participate in the decrease in insulin sensitivity at the whole body level during the transition toward physical inactivity	ENCORI
ENSG00000174437	ATP2A2	protein_coding	MIMAT0000759	hsa-miR-148b-3p	Increase in muscle miR-148b content might thus participate in the decrease in insulin sensitivity at the whole body level during the transition toward physical inactivity	ENCORI
ENSG00000184557	SOCS3	protein_coding	MIMAT0000759	hsa-miR-148b-3p	Increase in muscle miR-148b content might thus participate in the decrease in insulin sensitivity at the whole body level during the transition toward physical inactivity	ENCORI
ENSG00000205542	TMSB4X	protein_coding	MIMAT0000759	hsa-miR-148b-3p	Increase in muscle miR-148b content might thus participate in the decrease in insulin sensitivity at the whole body level during the transition toward physical inactivity	ENCORI
ENSG00000065809	FAM107B	protein_coding	MIMAT0000765	hsa-miR-335-5p	miR-335-5p is associated with differing proliferative processes in bone	ENCORI
ENSG00000101558	VAPA	protein_coding	MIMAT0000765	hsa-miR-335-5p	miR-335-5p is associated with differing proliferative processes in bone	ENCORI
ENSG00000111716	LDHB	protein_coding	MIMAT0000765	hsa-miR-335-5p	miR-335-5p is associated with differing proliferative processes in bone	ENCORI
ENSG00000119655	NPC2	protein_coding	MIMAT0000765	hsa-miR-335-5p	miR-335-5p is associated with differing proliferative processes in bone	ENCORI
ENSG00000122497	NBPF14	protein_coding	MIMAT0000765	hsa-miR-335-5p	miR-335-5p is associated with differing proliferative processes in bone	ENCORI
ENSG00000239672	NME1	protein_coding	MIMAT0000765	hsa-miR-335-5p	miR-335-5p is associated with differing proliferative processes in bone	ENCORI
ENSG00000113648	H2AFY	protein_coding	MIMAT0001339	hsa-miR-422a	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-422a	ENCORI
ENSG00000141298	SSH2	protein_coding	MIMAT0001339	hsa-miR-422a	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-422a	ENCORI
ENSG00000157020	SEC13	protein_coding	MIMAT0001339	hsa-miR-422a	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-422a	ENCORI
ENSG00000161091	MFSD12	protein_coding	MIMAT0001339	hsa-miR-422a	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-422a	ENCORI
ENSG00000182093	WRB	protein_coding	MIMAT0001339	hsa-miR-422a	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-422a	ENCORI
ENSG00000198242	RPL23A	protein_coding	MIMAT0001339	hsa-miR-422a	Expression of inflammatory and macrophage-related genes was opposite to decreased miR-422a	ENCORI

ENSG00000048828	FAM120A	protein_coding	MIMAT0001532	hsa-miR-448	miR-448 and its target gene SIRT1 can serve as prognostic indicators for obese T2DM patients after laparoscopic bariatric surgery	ENCORI
ENSG00000074855	ANO8	protein_coding	MIMAT0001532	hsa-miR-448	miR-448 and its target gene SIRT1 can serve as prognostic indicators for obese T2DM patients after laparoscopic bariatric surgery	ENCORI
ENSG00000086062	B4GALT1	protein_coding	MIMAT0001532	hsa-miR-448	miR-448 and its target gene SIRT1 can serve as prognostic indicators for obese T2DM patients after laparoscopic bariatric surgery	ENCORI
ENSG00000096384	HSP90AB1	protein_coding	MIMAT0001532	hsa-miR-448	miR-448 and its target gene SIRT1 can serve as prognostic indicators for obese T2DM patients after laparoscopic bariatric surgery	ENCORI
ENSG00000100644	HIF1A	protein_coding	MIMAT0001532	hsa-miR-448	miR-448 and its target gene SIRT1 can serve as prognostic indicators for obese T2DM patients after laparoscopic bariatric surgery	ENCORI
ENSG00000106546	AHR	protein_coding	MIMAT0001532	hsa-miR-448	miR-448 and its target gene SIRT1 can serve as prognostic indicators for obese T2DM patients after laparoscopic bariatric surgery	ENCORI
ENSG00000115310	RTN4	protein_coding	MIMAT0001532	hsa-miR-448	miR-448 and its target gene SIRT1 can serve as prognostic indicators for obese T2DM patients after laparoscopic bariatric surgery	ENCORI
ENSG00000149084	HSD17B12	protein_coding	MIMAT0001532	hsa-miR-448	miR-448 and its target gene SIRT1 can serve as prognostic indicators for obese T2DM patients after laparoscopic bariatric surgery	ENCORI
ENSG00000153071	DAB2	protein_coding	MIMAT0001532	hsa-miR-448	miR-448 and its target gene SIRT1 can serve as prognostic indicators for obese T2DM patients after laparoscopic bariatric surgery	ENCORI
ENSG00000153317	ASAP1	protein_coding	MIMAT0001532	hsa-miR-448	miR-448 and its target gene SIRT1 can serve as prognostic indicators for obese T2DM patients after laparoscopic bariatric surgery	ENCORI
ENSG00000168175	MAPK1IP1L	protein_coding	MIMAT0001532	hsa-miR-448	miR-448 and its target gene SIRT1 can serve as prognostic indicators for obese T2DM patients after laparoscopic bariatric surgery	ENCORI
ENSG00000185963	BICD2	protein_coding	MIMAT0001532	hsa-miR-448	miR-448 and its target gene SIRT1 can serve as prognostic indicators for obese T2DM patients after laparoscopic bariatric surgery	ENCORI
ENSG00000205542	TMSB4X	protein_coding	MIMAT0001532	hsa-miR-448	miR-448 and its target gene SIRT1 can serve as prognostic indicators for obese T2DM patients after laparoscopic bariatric surgery	ENCORI

ENSG00000011454	RABGAP1	protein_coding	MIMAT0002809	hsa-miR-146b-5p	causing lipoapoptosis of pancreatic islet cells, resulting in insulin deficiency and increased miR-146b-5p was associated with FABP4 and decreased glucose metabolism and FA mobilization	ENCORI
ENSG00000022267	FHL1	protein_coding	MIMAT0002809	hsa-miR-146b-5p	causing lipoapoptosis of pancreatic islet cells, resulting in insulin deficiency and increased miR-146b-5p was associated with FABP4 and decreased glucose metabolism and FA mobilization	ENCORI
ENSG00000025800	KPNA6	protein_coding	MIMAT0002809	hsa-miR-146b-5p	causing lipoapoptosis of pancreatic islet cells, resulting in insulin deficiency and increased miR-146b-5p was associated with FABP4 and decreased glucose metabolism and FA mobilization	ENCORI
ENSG00000239672	NME1	protein_coding	MIMAT0002809	hsa-miR-146b-5p	causing lipoapoptosis of pancreatic islet cells, resulting in insulin deficiency and increased miR-146b-5p was associated with FABP4 and decreased glucose metabolism and FA mobilization	ENCORI
ENSG00000001631	KRIT1	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type 2 diabetes in Duodenal-jejunal bypass	ENCORI
ENSG00000026025	VIM	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type 3 diabetes in Duodenal-jejunal bypass	ENCORI
ENSG00000035687	ADSS	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type 4 diabetes in Duodenal-jejunal bypass	ENCORI
ENSG00000085224	ATRX	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type 5 diabetes in Duodenal-jejunal bypass	ENCORI
ENSG00000087086	FTL	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type 6 diabetes in Duodenal-jejunal bypass	ENCORI
ENSG00000093000	NUP50	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type 7 diabetes in Duodenal-jejunal bypass	ENCORI
ENSG00000095787	WAC	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type 8 diabetes in Duodenal-jejunal bypass	ENCORI
ENSG00000114353	GNAI2	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type 9 diabetes in Duodenal-jejunal bypass	ENCORI
ENSG00000117143	UAP1	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type 10 diabetes in Duodenal-jejunal bypass	ENCORI
ENSG00000130770	ATP5IF1	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type 11 diabetes in Duodenal-jejunal bypass	ENCORI
ENSG00000135297	MTO1	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type 12 diabetes in Duodenal-jejunal bypass	ENCORI
ENSG00000140836	ZFHX3	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type 13 diabetes in Duodenal-jejunal bypass	ENCORI

ENSG00000141985	SH3GL1	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type diabetes in Duodenal-jejunal bypass	14	ENCORI
ENSG00000143761	ARF1	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type diabetes in Duodenal-jejunal bypass	15	ENCORI
ENSG00000150961	SEC24D	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type diabetes in Duodenal-jejunal bypass	16	ENCORI
ENSG00000156875	MFSD14A	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type diabetes in Duodenal-jejunal bypass	17	ENCORI
ENSG00000166548	TK2	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type diabetes in Duodenal-jejunal bypass	18	ENCORI
ENSG00000166925	TSC22D4	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type diabetes in Duodenal-jejunal bypass	19	ENCORI
ENSG00000167460	TPM4	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type diabetes in Duodenal-jejunal bypass	20	ENCORI
ENSG00000169045	HNRNPH1	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type diabetes in Duodenal-jejunal bypass	21	ENCORI
ENSG00000172795	DCP2	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type diabetes in Duodenal-jejunal bypass	22	ENCORI
ENSG00000175348	TMEM9B	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type diabetes in Duodenal-jejunal bypass	23	ENCORI
ENSG00000179010	MRFAP1	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type diabetes in Duodenal-jejunal bypass	24	ENCORI
ENSG00000185722	ANKFY1	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type diabetes in Duodenal-jejunal bypass	25	ENCORI
ENSG00000283761	AC118553.2	protein_coding	MIMAT0005793	hsa-miR-320c	regulates the adipoR1-mediated amelioration of type diabetes in Duodenal-jejunal bypass	26	ENCORI