

# An Overview of Metabolomics Studies Based on Qatari Population

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**Abstract.** The aim of metabolomics research is to identify the metabolites that play a role in various biological traits and diseases. This scoping review provides an overview of the current state of metabolomics studies that focus on the Qatari population. Our findings indicate that few studies have been conducted on this population, with a focus on diabetes, dyslipidemia, and cardiovascular disease. Blood samples were the primary source of metabolite identification, and several potential biomarkers for these diseases were proposed. To the best of our knowledge, this is the first scoping review that presents an overview of metabolomics studies in Qatar.

**Keywords.** Metabolomics, Qatar, Qatar Biobank (QBB).

## 1. Introduction

The broad study of metabolites, or small compounds, found in cells, biofluids, tissues, and organisms is known as metabolomics [1]. Finding steady-state metabolite concentrations and studying metabolic system control requires using metabolic profiling, which has become a crucial technique in drug discovery [2]. Metabolomics analysis provides comprehensive profiling of small molecule metabolites in cells or tissues and their role in different diseases [1]. As Qatar is focusing on building precision medicine-based healthcare, this scoping review aims to summarize the current status of metabolomics studies in Qatar, focusing on multiple diseases for identification of potential biomarkers.

## 2. Methods

This review was conducted adhering to the “PRISMA-P (Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols)” guidelines. Structured literature searching on the relevant topic was conducted in three bibliographic databases: MEDLINE, Google Scholar, and IEEE. The literature search was from 2015-2022. The searching was done for free-text terms for the keyword “metabolomics”. The concept of “metabolomics” was combined with “Qatar” using the boolean operator AND. All database references were exported to Zotero software to avoid duplication and final screening. The criteria identified for the inclusion and exclusion phases are given below

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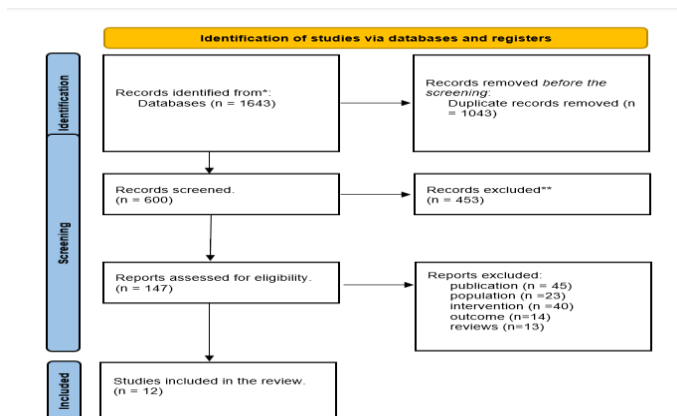
(Table 1). The review team consisted of four researchers. Each member was assigned one-third of the selected papers. Thus, each article was reviewed by two reviewers, independently. In case of conflicts among reviewers, it was resolved by discussion to reach a consensus.

**Table 1.** Inclusion and exclusion criteria

Parameter	Inclusion Criteria	Exclusion Criteria
Timeframe	2015-2022	Before 2015
Language	English	Other languages except English
Population	Qatar population	All other population
Outcome	Metabolites responsible for diseases	Everything except metabolites
Study type	Research articles, thesis and reports	Protocols, opinions, review, newspaper etc.

### 3. Results

Six hundred studies were identified after removing duplicates (Figure 1). After reviewing the titles, and abstracts, 345 articles were chosen to screen of their full texts. Most of the 345 studies that weren't used were left out because they were about something else, weren't written in English, were reviews, or weren't original studies. Some studies were conducted on plants, which we excluded. We also excluded articles outside Qatar as we were interested in studies based on Qatari cohort. In total, 12 full-text articles were eligible for this scoping review, and two more were added after a manual search (Table 2).



**Figure 1.** Flow diagram of literature search and study selection

**Table 2.** Summarized results of diseases and metabolites in the Qatari population.

Ref	Sample	Count ry	Disease	Metabolites discovered
[3]	Blood	Qatar	diabetes	OIS:choline, GPC, 1,5-AG or their comorbidities OIR:Glycerophosphoethanolamine, glucose.
[4]	Blood	Qatar	PCOS pregnant women	triglycerides containing arachidonic acid,palmitic acid, linoleic acid, Phosphatidylcholine diacyl.

[2]	Blood	Qatar	vit-D deficient people	sphingomyelins, PC, PE, N-stearoyl-sphingosine(ceramide), lysophospholipids.
[5]	Blood, urine, saliva	Qatar	diabetes	dimethylamine, betaine, mannitol,N,N-dimethylglycine, glucose, and b-alanine.
[6]	Plasma, urine, saliva	Qatar, non-Qatari	diabetes, colorectal cancer.	1,5-AG,glucose , <i>o</i> -cresol sulfate(colorectal cancer)
[7]	Blood, saliva	Qatar	diabetes	1,5-AG,galactose
[8]	Blood	Qatar	lean/overweight IR females	1-carboxyethyl phenylalanine,gamma-glutamyl phenylalanine,10-heptadecenoate, fructosyllysine, N-acetyl=aspartyl- glutamate,N-acetyl glycine, eicosoneote, glucuronide, palimitoleate.
[9]	Saliva, blood, urine	Qatar and Asian	diabetes	1,5-AG,2-hydroxybutyrate,b-hydroxypyruvate,4-hydroxyphenylpyruvate,xylonate,gluconate,ribose, mannose.
[10]	Blood	Qatar	BP	urate, dihomo-linolenate, lactate, Cis-4-decenoyl carnitine.
[11]	Blood	Qatar	Covid-19 (diabetes and BP patients)	decreased levels of triglycerides(palmitic acid, oleic,docosahexaenoic acid, docosapentaenoic acid.
[12]	Blood (serum)	Qatar and New York	Multi-omics	Phenylalanine, tryptophan, sphingolipids, hexanoylcarnitine, L-carnitine, caprylic acid, cytosine, arachidonic acid.
[13]	Blood	Qatar	CHD	Ornithine, arginine, leucine, isoleucine and valine, acylcarnitines

#### 4. Discussion

Through our scoping review, we were able to identify 12 articles that examined the relationship between metabolites and various diseases in the Qatari population (see Table 2). The majority of these studies focused on diabetes, cardiovascular disease (specifically coronary heart disease and blood pressure), and vitamin D deficiency. Additionally, the studies primarily analyzed lipids in blood samples to identify potential biomarkers, utilizing participants from the Qatar Biobank [6]. Dyslipidemia and deficiency of vitamin D deficiency significantly impact several metabolites, such as ergothioneine, CMPF, sphingomyelins, and ceramides, as well as downstream pathways, with PC and PE feeling the most strongly [2]. Another investigation [4] revealed a significant increase in serum triglycerides, particularly in PCOS-related newborns, and a lower birth weight compared to lean controls. The byproducts of gluconeogenesis, such as glucose and its polymer, were found at increased quantities in T2D, with increased amounts of glutamate, glycine-betaine (betaine), and betaine in [5]. Another study [6] discovered 138 multi-omics associations at CpG sites, including proteins, smoking-specific metabolites, and diabetes biomarkers. Halama et al. examined a potential technique for quantifying 1,5-AG in saliva samples using the Glycomark kit [7]. Long-chain fatty acids, Steroids, and metabolites from the microbiome are just a few of the potential biomarkers for IR (insulin resistance) [8]. 94 metabolite correlations with diabetes were discovered in [9], many of which have already been published and verified in other populations. 16 of these connections are in metabolic pathways that are involved in diabetes. ML techniques have revealed that traditional risk factors, metabolites, and food are the most accurate predictors of blood pressure, but genetics (SNPs) do not seem to have a significant effect [10]. Another finding [11] indicated that hypertensive

individuals with more severe conditions had lower levels of C22:6 (DHA) acids and triacylglycerols containing C22:5 (DPA), and higher levels of oleic (C18:1) acids. Metabolite risk score was created to evaluate the accuracy of CHD prediction using machine learning and multivariate analysis [13]. Our study has some limitations that need to be highlighted. The present study limited its scope to research published within the last seven years, specifically from 2015 to 2022, in order to provide an up-to-date analysis of the topic. Additionally, studies in languages other than English were not considered in the analysis.

## 5. Conclusion

The present review provides a summary of metabolomics studies conducted in Qatar. Our analysis revealed a predominant focus on diabetes and cardiovascular disease, with limited research conducted on COVID-19 and cancer. By identifying metabolic biomarkers associated with these diseases, the findings of these studies may contribute to the development of personalized medicine in Qatar as well as in the Gulf region.

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