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CORRESPONDENCE

OBESI-NET: an Italian network proposal for AI-supported obesity monitoring and precision medicine

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Abstract
Obesity requires structured and coordinated surveillance, because clinical, anthropometric, behavioural, technological, and epidemiological information is often collected in fragmented systems. In Italy, data on obesity and its comorbidities are distributed across registries, observational studies, and local institutional initiatives. This fragmentation limits longitudinal monitoring, national comparability, and the development of data-driven tools for prevention, diagnosis, and clinical management. This paper presents the conceptual proposal of OBESI–NET (Osservatorio Basato su Ecosistema Sanitario Digitale di Intelligenza Artificiale per l'Obesità–NETwork Nazionale). OBESI–NET is proposed as a national software ecosystem intended to connect Italian Society of Obesity clinical centers, healthcare professionals, and artificial intelligence engineering groups. The proposed infrastructure would support the standardized collection, secure integration, and analysis of heterogeneous data. These data include clinical, behavioural, anthropometric, imaging, wearable sensor, and, in future developments, multi-omics data. The expected contribution of OBESI–NET is not the presentation of an already implemented system, but the definition of a national model for obesity-centerd digital surveillance and AI (Artificial Intelligence)-supported precision medicine. Compared with existing digital obesity projects and registries, the proposal emphasizes integration within routine clinical practice and coordination through SIO (Società italiana dell'Obesità) centers. It also emphasizes longitudinal real-world data collection, multimodal data integration, and privacy-preserving approaches, such as federated learning. If implemented and validated, OBESI–NET could provide a framework for epidemiological monitoring, clinical research, treatment stratification, and public health planning in obesity care.
Level of Evidence: Level V, expert opinion and conceptual project proposal.

Keywords Obesity · Artificial intelligence · Italian Network · Precision medicine

Introduction

Obesity is a major global public health challenge, with prevalence more than doubling since 1990. It is associated with a substantial burden of non-communicable diseases, including diabetes, cardiovascular disease, and other chronic conditions [20, 40, 45]. In Italy, according to the latest ISTAT (Istituto nazionale di StATistica) survey in 2025, 46.4% of the population over 18 is overweight [27]. Although this figure appears relatively stable, the same report indicates that obesity has increased over the last decade, from 9.8% to 11.6%. Men are more affected than women, with 55.1% of men and 38.2% of women affected by overweight or obesity [31]. The increase in obesity is clinically relevant, because obesity is a chronic disease associated with multiple comorbidities, complications, and healthcare costs [3, 4].

The clinical problem is not limited to prevalence. Obesity management requires longitudinal information on clinical status, anthropometric measures, behavioural factors, treatments, outcomes, and comorbidities. In future developments, imaging, wearable-sensor data, and omics information may further enrich this characterization. However, these data are often collected in fragmented systems, including registries, observational studies, electronic health records, and local institutional initiatives. This fragmentation limits national comparability, long-term follow-up, treatment stratification, and the evaluation of interventions in routine clinical practice. For

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this reason, obesity requires a coordinated infrastructure able to transform routine clinical activity into structured real-world evidence [29, 36, 43].

Artificial intelligence represents a possible methodological response to this need, because obesity-related data are heterogeneous, high-dimensional, and longitudinal. Machine learning and multimodal AI can support the integration of different data sources, the identification of patient subgroups, the prediction of risk trajectories, and the development of decision-support tools. In this perspective, AI is not proposed as a generic technological addition, but as a tool to address specific limitations of fragmented and heterogeneous data collection. At the same time, AI should not be considered a stand-alone solution. Its clinical usefulness depends on data quality, representativeness, external validation, interpretability, bias assessment, clinician oversight, and integration into existing care pathways [42].

Deep phenotyping may contribute to this framework by combining clinical manifestations with molecular, behavioural, and technological data. Such integration could support more precise patient stratification and, in selected contexts, more personalized obesity management. Nevertheless, the transition from deep phenotyping to personalized treatment remains challenging. It requires robust longitudinal datasets, standardized variables, prospective validation, and evidence that phenotype-based models improve clinically meaningful outcomes. The UK Biobank experience illustrates how large-scale, well-organized biomedical data infrastructures can enable advanced data-driven research. For example, large proteomic analyses in the UK Biobank have shown the potential of linking structured biological information with genetics and health outcomes [38]. In the present manuscript, this example is not intended as a direct model for obesity care. Rather, it motivates the need for an obesity-specific Italian infrastructure capable of connecting standardized longitudinal data collection with AI-supported analysis.

On this basis, OBESI–NET is proposed as a national software ecosystem for obesity-centerd monitoring and comprehensive management. Its aim is to integrate clinical centers, healthcare professionals, and AI engineering groups within a shared framework for longitudinal real-world data collection, multimodal analysis, and privacy-preserving model development. The following section, therefore, focuses on existing digital platforms, registries, and AI-supported initiatives in obesity and metabolic disease, in order to clarify the specific gap addressed by OBESI–NET.

Scientific background

In this section, an overview of the current most important projects on data management, storage and AI-guided analysis in the field of obesity research are considered. The projects are selected on the basis of their relevance to the field of obesity in relation to artificial intelligence. Particular emphasis is placed on AI-supported data collection during patient treatment. Specifically, the selection focused on the most recent projects identified through official platforms, such as CORDIS and ClinicalTrials. This was done in order to ensure the use of reliable and up-to-date sources. For each project, a brief description is given. Particular focus is placed on multicentric data sourcing, the creation of AI-guided digital platform, artificial intelligence applications, and heterogeneous data collection. The projects are subdivided into 2 broad categories on the basis of geographic area: European and Extra-European projects. Some projects have been completed, whereas others are still ongoing. Note that particular attention is given to pediatric obesity. This represents a specific focus for some of them. As regards European projects“Big data against childhood Obesity” [17], or briefly BigO, is an international, multicentric project on pediatric obesity. An interactive data platform has been developed to collect and compare heterogeneous data about 3,700 children. These data come from 33 schools and 2 clinics across 5 European countries (Greece, Sweden, Ireland, Spain and the Netherlands) [16, 18]. The “NoHoW protocol” is a multicentric project aimed at testing the effectiveness of a digital toolkit comprising wearable devices for long-term weight loss maintenance (WLM). It is primarily a digital interventional trial on weight maintenance, not a national clinical surveillance/research infrastructure [33]. “BIO-STREAMS" [25] is an European ongoing project. It aims to create a large, multinational database on pediatric obesity, use AI to predict risk, and test whether these models can help clinicians. Another outcome explicitly defines it as a project aimed at developing a digital platform for the prevention and treatment of obesity in children and adolescents. Furthermore, a related trial is described as a multicenter study. It includes a mobile app and personalized recommendations in six European countries [44]. "GroHealth W8Buddy" is a digital platform delivering Specialist Weight Management Services. It uses structured data collection via app-based tools integrated into clinical pathways. It enables large-scale remote support. It combines monitoring, patient engagement, and real-world data acquisition across multiple NHS (National Health Service) centers. However, despite its scalability and clinical integration, W8Buddy seems to be a specialized digital service. It does not seem to be a comprehensive national infrastructure for research, epidemiological surveillance, or federated AI-driven analysis [15, 24]. As regards non-European projects,“International Weight Control Registry (IWCR)” [6] is a structured research registry. It is designed to collect heterogeneous data on weight loss and maintenance across diverse populations. It integrates demographic, behavioral, psychological, environmental, and objective clinical measures. This supports a precision-oriented approach to weight

management. With a multicountry perspective, it follows a large and diverse cohort to investigate determinants of success and inform interventions. However, IWCR functions as an international research registry rather than a nationally integrated platform embedded within routine clinical practice [32]. "China Diabetes Registry by Metabolic Management Center (CDR–MMC) [5]. The project describes a nationwide network based on a prospective, multicenter database supported by an internet health platform. This enables large-scale data collection and big-data analysis for standardized management pathways. It aims to harmonize clinical practices through unified protocols and structured data integration across centers. This supports epidemiological research and longitudinal monitoring. However, no specific component is dedicated to obesity-focused artificial intelligence. The primary focus remains on metabolic diseases, particularly diabetes, rather than obesity as a central condition. This is true even if there is a relationship between obesity and diabetes as shown in [34]. "Hong Kong Diabesity Register & integrated care trial" [7] is an ongoing project using a multicenter framework. This framework integrates a structured registry with digital disease management tools to support longitudinal care of patients with diabesity (diabetes+obesity). It combines systematic data collection with an e-health platform and interdisciplinary interventions. This enables coordinated and personalized management across sites. However, the project primarily targets combined diabetes and obesity management. It does not establish a comprehensive, national-level platform specifically dedicated to obesity research, surveillance, or large-scale integrated infrastructure. Artificial intelligence is limited to a chatbot for patient interaction and support, without the use of predictive modeling, advanced data analysis, or decision-support systems within the overall framework.

Aim

Obesity can be characterized as an epidemiological phenomenon with a high degree of complexity. It shows heterogeneity by age, sex, and generational cohort. Behavioral, socioeconomic, and clinical factors are additional dimensions. It increases with age, with a structural difference in the evolution of the phenomenon between males and females. It also shows a cohort effect that disproportionately affects more recent generations. This suggests a progressively earlier onset of disease burden and a gradual worsening over time [26]. These findings are consistent with those reported by the World Health Organization [45] and large global studies. These sources classify obesity as a chronic disease with heterogeneous etiology. Social and economic inequality are contributing factors to its onset. Obesity also impacts the healthcare system with significant consequences through its associated comorbidities [20].

In this context, the proposed OBESI–NET project aligns with the statistical evidence by proposing a paradigm shift compared to traditional models of surveillance and clinical management. The development of an integrated national platform will enable the elimination of the current fragmentation of information. This will be achieved by collecting and analyzing epidemiological, clinical, anthropometric, and behavioral data from a longitudinal and multiregional perspective. This approach addresses the empirically established need for continuous and adaptive monitoring of chronic conditions, such as obesity and related comorbidities [29].

A key aspect of OBESI–NET will be the investigation of treatments for individuals with obesity. This is in line with the growing development of innovative interventions, including pharmacological approaches. The platform will allow particular attention to effectiveness, safety, and adherence to control standards of intervention strategies for each of the integrated clinical and behavioral components. This is fully aligned with current scientific and regulatory guidelines. These guidelines have begun to recognize the value of digital, observational data and "real-world evidence" as a complement to randomized clinical trials, particularly for evaluating effectiveness in routine clinical practice [36, 43].

Despite the high technological content of the project, the human factor remains fundamental. The clinical observatory, at the core of the project, will involve a national network of physicians. These include nutritionists, endocrinologists, general practitioners, and specialists. It will collect information through digital tools, both desktop and mobile. This collaborative model will enable the transformation of routine clinical activity into a structured source of high-quality data. It will reduce the gap between clinical practice and research. The literature documents how the use of point-of-care digital tools improves the timeliness, accuracy, and standardization of data collection. At the same time, these tools improve the engagement of healthcare professionals in the epidemiological surveillance process. AI engineering teams will ultimately be able to use "big data" to train deep learning algorithms. This will enhance analyses, predictions, and outcome evaluations while also strengthening the physician–patient relationship [42].

An additional element of paramount importance for compliance with regulatory requirements on data protection will be the adoption of federated learning architectures. In OBESI–NET, clinical and sensitive data will remain locally stored at the centers in Milan and Palermo. Artificial intelligence algorithms will be transferred, trained, and updated in a distributed manner. The entire process will be supervised by SIO centers, which will oversee the procedures adopted for the implementation of individual tasks. This approach

will enable the development of robust and generalizable predictive models without the need to centralize data. It will significantly reduce privacy risks and ensure compliance with the GDPR (General Data Protection Regulation). Numerous studies demonstrate that federated learning represents an effective solution for the collaborative analysis of healthcare data. It also maintains high standards of security and statistical reliability [30, 35].

From an organizational perspective, OBESI–NET will include the activation of two reference sites. One will be based on Milan and the other in Palermo. Their responsibility will be to coordinate data collection and analysis at the national level. This choice is driven by both logistical and scientific considerations. On one hand, it will enable coverage of geographic areas with different sociodemographic and epidemiological profiles. On the other, it will allow comparative analyses and studies on geographic variability. This is a crucial element in understanding health inequalities associated with obesity.

The Palermo unit will be based on the Human–Machine Interaction Laboratory. It has developed significant expertise in integrating Artificial Intelligence within the DICOM (Digital Imaging and COmmunications in Medicine) standard. In this context, it has designed a framework capable of extending a DICOM Information Object Definition (IOD) to accommodate the weights of a deep neural network. This approach partially addresses one of the major challenges in biomedical AI applications, namely, data security. Specifically, the IODeep framework enables the automated analysis of medical images and biomedical data directly within hospital PACS (picture archiving and communication system) servers [8]. Furthermore, the adoption of such a framework supports the implementation of Federated Learning paradigms. It centralizes the model while preserving the original data distribution, thus avoiding data sharing across institutions [1]. The multidisciplinary nature of the group has also fostered the development of expertise in the domains of Drug Discovery and Drug Repurposing. This expertise is based on the design of neural network architectures and graph-based explainability methodologies aimed at investigating molecular substructures involved in bioactivity mechanisms [9]. In addition, the group has acquired substantial experience in the application of Large Language Models (LLMs). This experience is particularly related to the implementation of retrieval-augmented generation (RAG) systems to support diagnostic and clinical decision-making processes, as well as the analysis of scientific literature [37]. These activities constitute the core business of the academic spin-off BIOGEN-IA s.r.l., which operates in the artificial intelligence market with a focus on advancing technological innovation in the biomedical field.

The Milan unit will be hosted at the Humanitas AI Center. This is a research center dedicated to the development and application of artificial intelligence in healthcare at the IRCCS Humanitas Research Hospital. The center brings together a multidisciplinary team composed of physicians, data scientists, engineers, bioinformaticians, and digital specialists. These professionals collaborate to develop innovative solutions aimed at improving the quality of care and the efficiency of clinical processes.

Embedded within an integrated ecosystem that includes hospital, research center, and university, the AI Center operates according to a translational medicine approach. In this approach, scientific research and technological development are closely aligned with clinical practice. This environment enables the development and validation of advanced artificial intelligence models based on large-scale clinical, genomic, and imaging data. These models support diagnosis, improving patient stratification, and personalizing treatments [11]. The center's activities include the development of machine learning and deep learning algorithms, the analysis of clinical and omics data, and computer vision applications for medical image analysis. They also include the use of natural language processing techniques on healthcare data [2, 14]. Through these technologies, the AI Center aims to contribute to the advancement of predictive and personalized medicine, enhancing care pathways and supporting clinical decision-making [39].

Train (https://www.train-ai.eu/) is a spin-off of the AI Center at IRCCS Humanitas Research Hospital. It was founded in 2023 with the objective of fostering innovation in clinical trials and personalized medicine through the use of generative artificial intelligence. The company develops advanced AI models for synthetic data generation [10]. It also works on the creation of patient digital twins and the design of innovative solutions for the management and optimization of clinical activities [28]. These technologies enable the acceleration of biomedical research and the improvement of clinical trial design. They also support increasingly personalized treatment strategies. Train's main competitive advantage lies in its close integration with the clinical and scientific environment of Humanitas. This allows for the development and validation of AI models on real-world data with the direct involvement of clinicians and researchers. This approach ensures strong scientific foundations and rapid translation of technological innovations into clinical practice.

The Humanitas AI Center and Train also participate in the European project SYNTHIA–Synthetic Data Generation Framework for Integrated Validation of Use Cases and AI Healthcare Applications. The project is funded under the Innovative Health Initiative (IHI) of Horizon Europe [https://www.ihi-synthia.eu/]. The project brings together more than thirty partners, including academic institutions, hospitals, technology companies, and pharmaceutical industries. Its aim is to develop advanced tools for the generation

and validation of synthetic data in healthcare. SYNTHIA seeks to establish a federated platform capable of generating realistic and multimodal synthetic datasets. These include clinical, genomic, medical imaging, and digital device data. The platform also preserves patient privacy [12]. The project also develops methodologies to assess the quality, safety, and applicability of synthetic data. These methodologies are intended for medical research and AI system development [13]. The technologies developed within the project are validated across multiple clinical domains, including solid and hematological cancers, neurodegenerative diseases, and type 2 diabetes. The objective is to demonstrate the potential of synthetic data to accelerate clinical research, enhance personalized medicine, and facilitate secure health data sharing at the European level. The relationship between the Humanitas AI Center and the European Society for Artificial Intelligence in Health (ESAIH) is further strengthened by the institutional connection provided by Victor Savevski. He serves as Director of the AI Center and Chief Innovation & Partnerships Officer at Humanitas while also acting as President of ESAIH. This dual role provides a natural interface between Humanitas' translational research activities and ESAIH's broader European mission of promoting responsible, clinically relevant, and evidence-based artificial intelligence in healthcare. Among the recent studies co-authored by Savevski, the work reported in [19] investigates the use of AI-generated synthetic data to improve the design and efficiency of surgical clinical trials, whereas the study presented in [41] demonstrates the application of natural language processing to identify patients potentially affected by inflammatory rheumatic diseases from unstructured emergency department clinical notes.

Organizational model for implementation

The implementation of OBESI–NET should be supported by an organizational model capable of translating the proposed digital infrastructure into routine clinical practice. Since obesity is a chronic and multifactorial condition, the effectiveness of the platform will depend not only on technological development, but also on the ability of healthcare organizations to coordinate professionals, procedures, data flows, and patient follow-up over time. Therefore, OBESI–NET should be conceived as a socio-technical infrastructure, in which digital tools, clinical responsibilities, organizational processes, and patient engagement are developed together.

Recent Italian experiences on integrated care provide useful indications in this direction. Giusti et al. described an organizational model developed to integrate health and social care resources and ensure continuity of care for frail individuals aged 65 years or over [23]. Although this experience was not focused on obesity, it is relevant, because it shows that the management of chronic and complex conditions requires coordinated pathways, shared responsibilities, and integration between different care settings. In the context of OBESI–NET, this perspective supports the need to define clear operational links between specialist care, territorial services, and longitudinal monitoring activities.

A second organizational dimension concerns the ability of healthcare institutions to make complex procedures understandable, accessible, and usable for both professionals and patients. Giusti et al. discussed Organizational Health Literacy as a tool supporting the implementation of complex regulatory and organizational changes in the Italian healthcare context [21]. This concept is particularly relevant for an AI-supported infrastructure, such as OBESI–NET. The use of digital platforms, predictive models, and risk stratification tools requires clear communication about data collection, consent procedures, clinical meaning, limitations of algorithmic outputs, and the role of professional judgement. Organizational health literacy may, therefore, contribute to improving the acceptability, transparency, and appropriate use of the platform.

The third relevant aspect is professional training. Giusti et al. analysed the role of Italian healthcare professionals in supporting organizational and digital reforms within the National Healthcare System, emphasizing the importance of professional involvement, multidisciplinary collaboration, and the development of new competencies [22]. For OBESI–NET, this implies that implementation should be accompanied by structured training activities. These activities should address not only the clinical management of obesity, but also digital data collection, data quality, privacy protection, real-world evidence, artificial intelligence literacy, bias recognition, and the clinical interpretation of predictive outputs.

From this perspective, the organizational model should include shared protocols, local implementation responsibilities, multidisciplinary coordination, continuous training, and feedback mechanisms from clinicians and patients. These components are necessary to prevent the platform from remaining a purely technological proposal. They may also support its progressive adoption as a sustainable, clinically meaningful, and ethically robust infrastructure for obesity monitoring and management.

Conclusions

OBESI–NET is presented in this paper as a conceptual project proposal for a future Italian national infrastructure dedicated to obesity monitoring and comprehensive management. The proposal is grounded in the current evidence on obesity as a chronic, heterogeneous, and multifactorial disease associated with major clinical, social, and economic

consequences. In this context, OBESI–NET is conceived as a coordinated framework aimed at integrating epidemiological observation, clinical participation, real-world data collection, and distributed artificial intelligence.

Several digital platforms, registries, and multicenter projects, like those in Sec.Scientific background, have already explored data collection, remote monitoring, or AI-supported analysis in obesity and metabolic disease. However, many of these initiatives are limited to single clinical objectives, interventional trials, or infrastructures that are not specifically designed as national obesity-centerd surveillance systems embedded in routine clinical practice. The expected contribution of OBESI–NET is, therefore, the definition of a national model that combines SIO-based clinical coordination, longitudinal real-world data collection, multimodal data integration, federated learning, and AI-supported precision medicine within a single planned ecosystem.

The main strength of the proposed framework is its obesity-centerd and national perspective. Unlike many existing registries or digital weight-management initiatives, OBESI–NET is conceived as an infrastructure specifically dedicated to obesity and its comorbidities. The proposal also benefits from multidisciplinary expertise, including clinical nutrition, obesity medicine, biomedical artificial intelligence, DICOM-based data integration, federated learning, synthetic data generation, and translational medicine. These elements may provide a basis for future epidemiological surveillance, clinical research, treatment stratification, and public health planning.

The main limitation is that OBESI–NET has not yet been implemented. Therefore, this paper does not report technical deployment, prospective patient recruitment, clinical outcomes, validation studies, or measured effects on healthcare processes. The proposed infrastructure should be interpreted as a conceptual and methodological framework rather than as an operational platform. Future work will need to address feasibility, interoperability with existing electronic health records, data governance, sustainability, clinician engagement, patient recruitment, and multicenter validation. Moreover, any AI-based model developed within the OBESI–NET framework will require external validation, bias assessment, transparency, and clinical interpretability before being used in decision-support scenarios.

In summary, this paper does not claim that OBESI–NET is already available or clinically validated. Rather, it defines the rationale, expected architecture, strengths, limitations, and potential contribution of a future national AI-supported infrastructure for obesity monitoring and precision medicine. If implemented and validated, OBESI–NET could support more coordinated surveillance, research, and decision-making in obesity care while contributing to sustainable and innovation-oriented public health policies.

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Data availability No datasets were generated or analysed during the current study.

Declarations

Competing interests The authors declare no competing interests.

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