Ann Ig. 2025 May-June; 37(3): 365-377. doi: 10.7416/ai.2024.2666. Epub 2024 Nov 7.

Funding sources for public health research in Italy

Riccardo Mazzoli[1], Maria La Torre[2], Vanessa E. Privitera[2], Nadja Sändig[2], Tommaso Filippini[1,3], Marco Vinceti[1,4]

Keywords: Funding; public health; research; communicable diseases; non-communicable diseases; vaccines
Parole chiave: Fonti di finanziamento; Sanità Pubblica; ricerca; malattie infettive; malattie croniche; vaccini

Abstract

Background. *Funding sources play a critical role in shaping the landscape of scientific research, including the one in public health, as they often determine not only the feasibility of specific projects but also its broader directions.*
Study design. *We aimed at assessing current funding sources for public health research in Italy and related implications.*
Methods. *We conducted a systematic PubMed search from January 2023 to June 2024, focusing on publications by 208 Italian tenured professors in hygiene and public health. We included only original articles they authored as first or last authors, excluding editorials, comments, and letters. We categorized funding sources into public internal, public external, private external, and unmentioned.*
Results. *We retrieved 760 non-duplicate eligible publications. Research topics focused almost equally on communicable (48.2%) and non-communicable (51.8%) diseases. Public external funding were the most common overall (33.7%), followed by private external (14.3%) and public internal (7.5%). Notably, 58.7% of studies did not report any funding sources. Private external, regional and EU sources predominantly funded communicable disease research, while non-communicable disease research received more support from public external sources, especially governmental.*
Conclusions. *In a European country such as Italy the funding landscape in public health research appears to be complex, due to the wide range of topics and intertwined roles of funding actors. Public funding are more frequent than private funding also independently of research topics, though most research activities did not require specific financial support, implying that public health research frequently has limited financial needs. This likely enables more flexibility and independence to investigators in public health, with major implications in terms of feasibility and absence of conflicts of interest.*

[1] *Environmental, Genetic and Nutritional Epidemiology Research Center (CREAGEN), Department of Biomedical, Metabolic and Neural Sciences, University of Modena and Reggio Emilia, Modena, Italy*
[2] *Department of Biomedical, Metabolic and Neural Sciences, University of Modena and Reggio Emilia, Modena, Italy*
[3] *School of Public Health, University of California Berkeley, Berkeley, CA, USA*
[4] *Department of Epidemiology, Boston University School of Public Health, Boston, MA, USA*

Annali di Igiene : Medicina Preventiva e di Comunità (Ann Ig)
ISSN 1120-9135 https://www.annali-igiene.it

Introduction

Public health research is essential for advancing healthcare systems, informing policy decisions, and improving population health (1,2). The source of funding for research is critical as it can affect scope, topics and direction of the studies conducted, and have a possible influence on their outcomes. Indeed, the Equator Network highlighted the importance to assess source of funding in final publication, particularly in experimental trials but also in general, when reporting research findings for transparency purpose (3). Across all scientific fields, the largest contributors to research funding are usually government agencies, followed by independent organizations and industries, while Universities and hospitals have been shown to contribute in a marginal way in all G9 countries (4,5). Funding from government and international agencies are the highest competitive with low (<20%) success rate (5-7). Industry and profit organizations, often the second largest funding source, drive substantial progress and are pivotal in Research & Development. Though, their direct and indirect financial support to researchers can also influence research directions (8,9). More recently, COVID-19 pandemic has greatly affected both research and development funding (10), with also silver lining related to health and social benefits as well as shortened timing as seen in ethics committee legislation (11).

A few studies conducted at the national level have assessed funding sources in specific research fields and over time (12-15). However, little is known about this issue in the public health area. In the present study, we aimed at systematically evaluating the funding sources in public health research, in order to provide insights into the financial landscape supporting public health publications in Italy and their implications.

Methods

Data collection

We searched in the PubMed database the publications authored by the 208 Italian full and associate university professors in hygiene and public health from January 2023 to June 2024. Public Health professors were retrieved via the database "Cerca Università" (https://cercauniversita.mur.gov.it) of the Italian Ministry of University and Research - MUR (5), and further divided according to the geographical location of their institutions, i.e. Northern (n=60, 39%), Central (n=42, 27%) and Southern (n=53, 34%) Italy. Since almost all Italian universities with affiliated public health investigators are public, with only three exceptions (Vita-Salute San Raffaele University, Catholic University of the Sacred Hearth and Humanitas University) but still subject to MUR control and funding, in our analysis we considered all the Italian academic institutions as public.

We limited our search to publications where these professors were listed as either first or last authors. This approach allowed us to identify papers most likely primarily focusing on the field of hygiene, preventive medicine, and public health in general, though without excluding topics by imposing thematic restrictions. We selected two leading authorship positions (first and last) as inclusion criterion, to include publication where Italian researchers should be the principal investigators and for this reason, the main recipients of the funding source, if any. As a consequence, we excluded national and international multicenter studies where the role of the individual Italian researcher could not be clearly identified as leading one. We did not apply filters on the type of papers, but we excluded editorials, comments, and letters during screening phase of title and abstract. For each article, RM, MLT, and VEP reviewed the full-text and extracted the following information: author, university or institution of affiliation, title of the study, and detailed funding information. Titles and PMIDs were used to identify duplicates and count each article one time only.

Data classification

We used the funding acknowledgements section of the papers to identify financial sources of support, and we categorized them in four macro-categories (16-18): public internal, public external, private external, and unmentioned. By "public internal", we refer to funding sourced directly from the researcher's own institution (given the almost entirely public nature of Italian universities). Conversely, "public external" includes all funding from public institutions, entities, and agencies outside of the researcher's university. Details of the funding entities included in each macro-category used for data extraction and categorization are provided in Table 1.

The researcher's affiliation allowed for geographical stratification. We divided the papers into three macro areas according Italian Institute of Statistics classification (19): Northern Italy (Valle d'Aosta, Piedmont, Liguria, Lombardy, Emilia Romagna, Veneto, Friuli Venezia Giulia, Trento and Bolzano), Central Italy (Umbria, Marche, Tuscany and Lazio),

Table 1 - Subdivision of macro-categories of sources of funding.

Category	Source of funding
Public internal	• "University of..." • University funded-grants (e.g., FAR, Pia.ce.ri, etc.)
Public external	• European Union (NextGeneration EU, Horizon Europe, Life, etc.) • EU-agencies (EFSA, ESA, etc.) • Italian government (MS-Ministry of Health, MUR-Ministry of University and Research, etc.) • MUR-specific programs (Departments of Excellence, PRIN, CTN, etc.) • Italian regional governments and/or regional entities • Regional and local health authorities and hospitals (IRCCS included) • International, non-EU related (Germany, Czech Republic, etc.) government funding • Extra-EU (Switzerland, USA) government funding • International projects (COST, bilateral research, etc.) • National and international public bodies (ISS, AIFA, WHO, etc.)
Private external	• Not-For-Profit Organizations (NFP), including non-governmental organizations (NGOs), foundations (AIRC, Fondazione Veronesi, etc.), and national and international scientific societies (SItI, EUPHA, etc.) • For-Profit companies unrelated to biomedical and pharmacological research, production or distribution • Pharmaceutical companies (Sanofi, Pfizer, etc.)
Unmentioned	• "No external funding" was declared, or when the funding source was not specified.

Acronyms: AIFA = Agenzia Italiana del Farmaco (Italian Medicine Agency); AIRC = Associazione Italiana per la Ricerca sul Cancro (Italian Association for Cancer Research); COST = European Cooperation in Science and Technology; CTN = Cluster Tecnologici Nazionali (National Technological Clusters); EFSA = European Food Safety Authority; ESA = European Space Agency; EUPHA = European Public Health Association; FAR = Fondo Ateneo per la Ricerca (University Research Fund); IRCCS = Istituto di Ricovero e Cura a Carattere Scientifico (Scientific Institute for Research, Hospitalization, and Healthcare); ISS = Istituto Superiore di Sannità (National Health Institute); Pia.ce.ri = Piano di incentivi per la Ricerca di Ateneo (University Research Incentive Plan); PRIN = Progetti di Rilevante Interesse Nazionale (Projects of National Relevance); SItI = Società Italiana Igiene e Medicina Preventiva (Italian Society of Hygiene and Preventive Medicine); WHO = World Health Organization.

and Southern Italy and islands (Abruzzo, Molise, Campania, Apulia, Basilicata, Calabria, Sicily and Sardinia).

Based on the research focus, we eventually categorized publications into two main groups: communicable disease, including vaccination, COVID-19, infectious disease, and antibiotic resistance; and non-communicable diseases, covering publications on cancer, neurological, cardiovascular, obstetric and gynecological, pediatric diseases as main categories.

Data analysis and data presentation

We extracted data using an Excel spreadsheet and we computed absolute and relative frequencies for the categorical variables using 'tabulate', 'tabstat', and 'graph hbar' commands of Stata v18 (StataCorp LCC, College Station, TX, 2023). We also used the website SankeyMATIC.com for Sankey Plot generation. Such tool allows to visually map the flow of funding from its original source, through its classification, to its final application in specific research topics. The tool therefore allowed to depict the proportional distribution, flow and relations between different funding sources and research areas, offering an immediate understanding of complex funding pathways and highlighting key patterns in the allocation of research resources.

Since some articles have received funding from multiple entities (i.e. public internal and external and private external) within the same macro-category (communicable or non-communicable disease), and/or were funded by entities across different macro-categories, the overall number of funding sources exceeded the number of publications. As a result, when comparing the total number of funding to the total number of publications, the sum of the percentages could exceed 100%.

Results

Between January 2023 and June 2024, we identified 1012 publications, of which 252 were duplicates, with total 760 eligible research publications. Furthermore, out of the 208 tenured and full professors investigated,

Table 2 - Distribution of funding divided by source, topic and geographical area. The sum of the percentages in each column exceeds 100% due to funding overlap in categories. Values are percentages and absolute numbers in parenthesis.

	Communicable disease (n = 366)	Non-communicable diseases (n = 394)	Total (n = 760)
North	44.8% (164)	61.0% (240)	53.2% (404)
Public Internal	2.5% (9)	5.1% (20)	3.8% (29)
Public External	14.8% (54)	18.8% (74)	16.8% (128)
Private External	6.6% (24)	6.9% (27)	6.7% (51)
Unmentioned	21.0% (77)	30.2% (119)	25.8% (196)
Center	25.7% (94)	24.9% (98)	25.3% (192)
Public Internal	1.6% (6)	1.8% (7)	1.7% (13)
Public External	4.6% (17)	6.3% (25)	5.5% (42)
Private External	4.4% (16)	4.6% (18)	4.5% (34)
Unmentioned	15.0% (55)	12.2% (48)	13.6% (103)
South	40.2% (147)	31.7% (125)	35.8% (272)
Public Internal	1.4% (5)	2.5% (10)	2.0% (15)
Public External	14.2% (52)	8.6% (34)	11.3% (86)
Private External	4.1% (15)	2.3% (9)	3.2% (24)
Unmentioned	20.5% (75)	18.3% (72)	19.3% (147)
Italy	110.8% (405)	117.5% (463)	114.2% (868)
Public Internal	5.5% (20)	9.4% (37)	7.5% (57)
Public External	33.6% (123)	33.8% (133)	33.7% (256)
Private External	15.0% (55)	13.7% (54)	14.3% (109)
Unmentioned	56.7% (207)	60.7% (239)	58.7% (446)

53 did not have any publications during the period under review, leaving 155 (males/females: 76/79) professors.

Table 2 presents distribution of funding based on source (public/private external/internal), topic (communicable/non communicable disease), and geographical area (North, Center, South).

As regards source of funding, public external funding were the most common source (33.7%), followed by private external (14.3%) and public internal (7.5%). A higher proportion of studies (58.7%) did not declare any funding source. The 760 eligible research publications almost equally focused into communicable (48.2%) and non-communicable diseases (51.8%). Northern Italy authors focused more on non-communicable diseases (58.5%), while communicable diseases were the main focus for most of the publications from Southern Italy researchers (57.0%). Details on the geographical distributions of the topics of retrieved articles are listed in Supplementary Table S1.

Regarding geographical distribution, some minor regional disparities according to source of funding can be acknowledged. In the North, public external funding were the main source (61.5%), followed by private external (24.5%), and public internal (13.9%). The South also remarkably highlighted public external funding (68.8%), while reporting less private external (19.2%) and public internal (12.0%) funding compared to the North. The Center shows a more balanced but smaller-scale funding distribution, with 47.2% from public external sources, 38.2% from private external funding, whereas 14.1% from public internal funding. However, it must be noted that more than half of publications (58.7%) did not report funding information.

Figure 1 visualizes through a Sankey-plot the distribution of funding sources for publications on communicable and non-communicable diseases, while Figure 2 shows how funding sources are allocated between communicable and non-communicable diseases. The distribution is generally in favor of non-communicable diseases in the case of public internal funding, Ministry of Health and University,

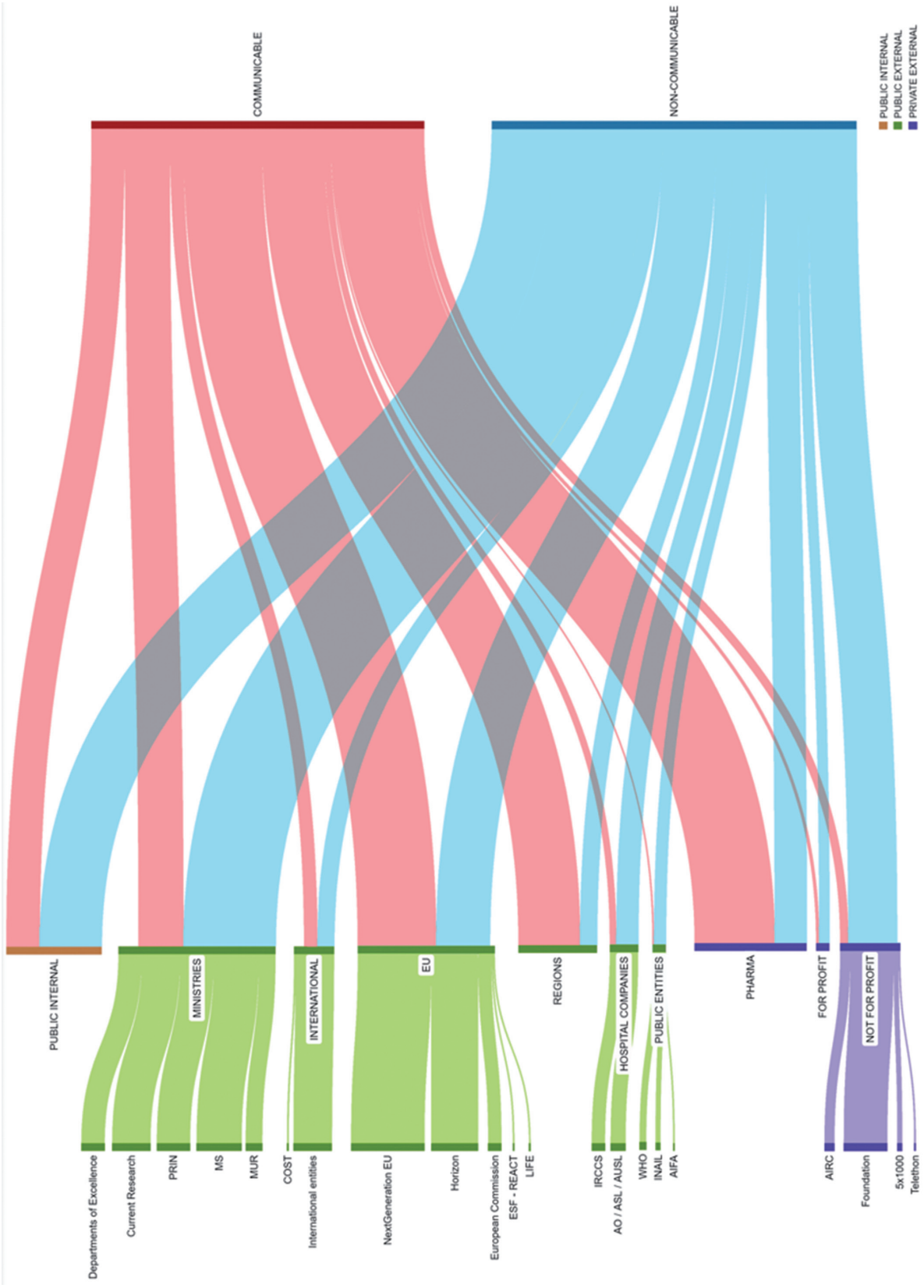


Figure 1 - Sankey-plot graph on funding allocation from source of funding to article topic (width of lines are proportional to the number of publication in each flow). Acronyms: AIFA = Agenzia Italiana del Farmaco (Italian Medicine Agency); AIRC = Associazione Italiana per la Ricerca sul Cancro (Italian Association for Cancer Research); COST = European Cooperation in Science and Technology; CTN = Cluster Tecnologici Nazionali (National Technological Clusters); EFSA = European Food Safety Authority; ESA = European Space Agency; EUPHA = European Public Health Association; FAR = Fondo Ateneo per la Ricerca (University Research Fund); IRCCS = Istituto di Ricovero e Cura a Carattere Scientifico (Scientific Institute for Research, Hospitalization, and Healthcare); ISS = Istituto Superiore di Sanità (National Health Institute); MUR = Ministero dell'Università e della Ricerca (Ministry of University and Research); MS = Ministero della Sanità (Ministry of Health); Pia.ce.ri = Piano di incentivi per la Ricerca di Ateneo (University Research Incentive Plan); PRIN = Progetti di Rilevante Interesse Nazionale (Projects of National Relevance); SItI = Società Italiana Igiene e Medicina Preventiva (Italian Society of Hygiene and Preventive Medicine); WHO = World Health Organization.

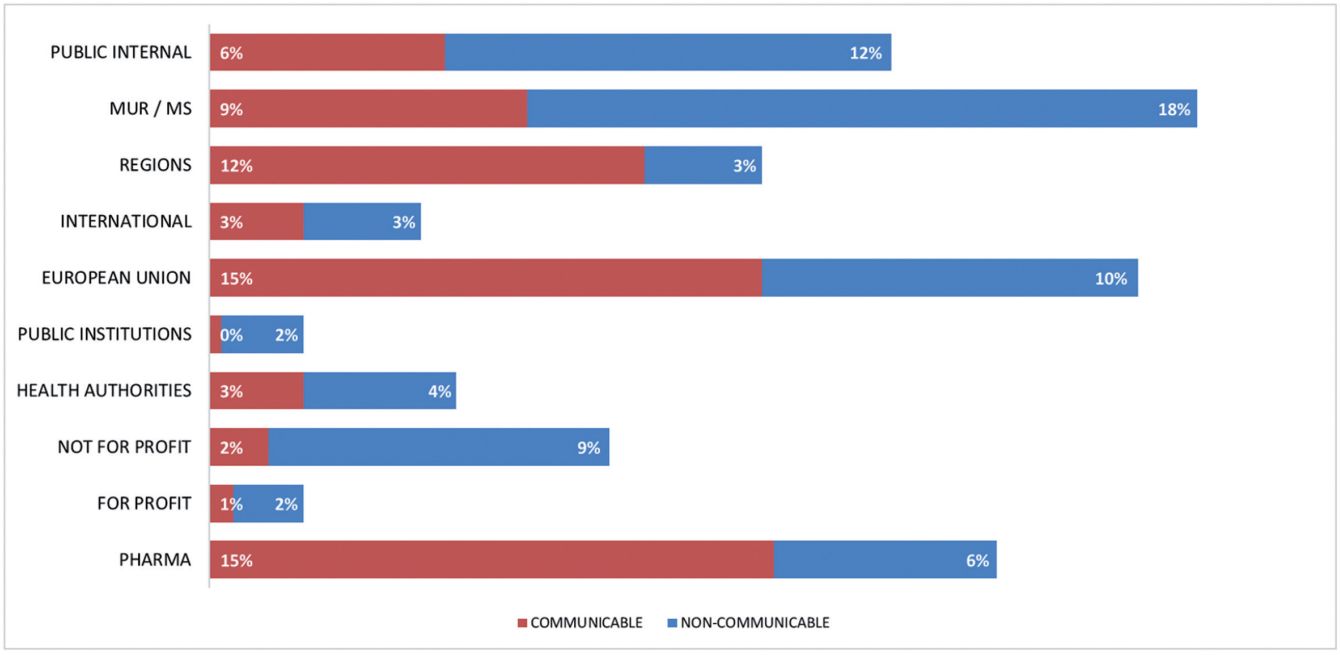


Figure 2 - Sources of funding by type of publication, excluding articles with unmentioned funding, total articles included (N=314). The sum of the percentages in each column exceeds 100% due to funding overlap in categories.
Acronyms: MUR = Ministero dell'Università e della Ricerca (Ministry of University and Research); MS = Ministero della Sanità (Ministry of Health).

and for not-for-profit organizations. On the converse, regional and EU funding were more common in the studies on communicable diseases, as compared to studies on non-communicable disease. Pharmaceutical companies more commonly funded research about communicable diseases (15%) compared to that on non-communicable diseases (6%).

Supplementary Figure S1 provides a detailed picture of the sources of funding by topic of publication.

Supplementary Table S2 shows the distribution of multiple sources of funding, also divided by geographical area. The majority of publications received funding from a single source, either public internal (7.5%), public external (7.5%), and private external (21.3%). A minority of the studies (6.5%) received multiple funding, generally public funds.

Discussion

Our investigation of funding sources currently supporting public health research in Italy showed a multidimensional landscape of financial opportunities and sources for Italian researchers, indicating the presence of a heterogeneous and dynamic research output in accordance with previous investigations conducted globally (18).

The distinction between funding for communicable and non-communicable diseases revealed targeted funding strategies, with the Ministry of Universities and Research, the Ministry of Health, and their funding calls and projects (e.g., Departments of Excellence, PRIN, etc.) showing a substantial focus on non-communicable diseases, possibly reflecting the public health burden of these diseases and the related financial implications in term of health care costs. Chronic conditions, such as cardiovascular disease and cancer, place in fact a considerable burden on healthcare systems (20). Furthermore, non-communicable diseases are the leading cause of mortality and morbidity in countries like Italy (21), which could explain why governmental agencies have decided to allocate relevant resources to research projects in the field of disease prevention and public health. In fact, in this research area the government-funded research showed a leading role, likely reflecting the awareness of the health burden associated with the high chronic disease prevalence in the population, and

the need to address related long-term health challenges (22,23). Addressing and supporting chronic disease prevention fully align with national health policies aimed at improving quality of life and at reducing the strain on the healthcare system, particularly as population ages (24).

Conversely, pharmaceutical companies exhibited a stronger investment in research on communicable diseases, a funding pattern that could align with the industry's interest in vaccine development and other treatments for infectious diseases, a priority likely more pronounced in the wake of the COVID-19 pandemic (25-27). This trend may be explained by market forces, i.e. the commercial potential of vaccine development and infectious disease treatment, particularly given the global demand for these products during and after public health emergencies such as the COVID-19 pandemic (28). Moreover, global health priorities, shaped by international organizations like the World Health Organization and national governments, increasingly emphasize the need to counteract the threat represented by both 'old' and emerging infectious diseases, especially for vulnerable groups like infants and the elderly. This may further incentivize pharmaceutical companies to allocate research resources to these areas (29).

This pattern contrasts with the approach by private non-profit and non-pharmaceutical for-profit entities, showing a more balanced picture and even a slight preference for supporting non-communicable diseases. These entities may choose to prioritize non-communicable diseases because these conditions align with their philanthropic goals, aimed at improving long-term societal well-being. This is particularly true for public health research in the fields of cancer, cardiovascular diseases, and mental health, which could arguably be seen as underfunded (30). For-profit organizations, such as insurance companies, may be more inclined to fund non-communicable disease research also to address the rising costs for management of chronic diseases, thus aligning their financial interests with the long-term sustainability of healthcare.

Funds like NextGeneration EU and Horizon exhibited a substantially even contribution to both disease categories, supporting an effective role of European funding in maintaining research diversity (31-33). Additionally, the relatively high prevalence of European Union and International funds in public health research within Italy suggests that Italian researchers are adequately integrated into the broader European and extra-EU research network. This allowed access to shared funding resources but also liked fostered cross-border collaboration and innovation. Unexpectedly, international entities like World Health Organization were a quite limited source of funding, with a slight emphasis on non-communicable diseases, possibly reflecting global health priorities of these sources (34,35). The limited international funding in Italy can also be explained by the global mandate of such agencies to allocate more resources to regions with fewer research capacities than Italy, specifically low-to-middle income countries where the scientific research networks and the healthcare systems may struggle to cope with chronic diseases (36).

As regards geographical area, it is important to acknowledge that the observed disparities in research focus and output between regions are likely influenced by the uneven geographical distribution of research institutions and personnel. Areas with a denser network of research facilities and academic institutions, such as Northern Italy, unavoidably reported higher number of publications. Researchers from Northern Italy focused on non-communicable disease, representing the 58.5% of the topics their publications. In contrast, the South gave emphasis to communicable diseases, comprising 57.0% of its research. However, this regional difference may also be attributed to varying public health needs, with Southern Italy facing more challenges in infectious diseases and Northern Italy needing to address chronic diseases more, which are more prevalent in aging and older populations, and in heavily polluted areas as frequently found in the industrialized areas characterizing Northern regions (37-41).

Public internal funding was not a major source of support across all regions and disease topics, representing only 3.8% of the total funding, highlighting the limited role of internal sources of specific financial support in public health research.

A high proportion of studies (58.7%) did not include funding sources, suggesting that public health research frequently relies on freely accessible research data or on already available resources (salaries, academic equipment, etc.). Therefore, in many instances specific 'additional' financial support, in addition to the basic one provided by Italian generally public academic institutions (tenure, and operational costs) and as such not formally acknowledged, was not needed to carry out scientific research in preventive medicine. While these are likely the most probable reasons underlying the absence of specific funding acknowledged by the investigators in the public health field, such an unexpectedly high rate of non-disclosure

warrants further examination, since also alternative reasons may at least in part explain it. Some journals could not explicitly require mandatory disclosure of funding sources (42), though this is unlikely to be a widespread approach, and they could also differ in their acknowledgment practices (43-45). Such a possible inconsistency in journal policies could contribute to underreporting, as researchers may not feel obligated to disclose all sources of funding, especially when the journal's guidelines are unclear or lenient, and could distort our understanding of the full spectrum of financial support behind public health research. However, transparency in research funding is necessary for maintaining the integrity of research (46-49): without detailed funding disclosures, it can be difficult for public, policymakers and practitioners to assess whether the research may be influenced by funders' interests. In some cases, researchers might unintentionally omit funding information due to oversight and permissive journal policies, but such omissions can anyhow lead to concerns about potential conflicts of interest, particularly if the funding source has a stake in the research outcomes. Given the potential impact of public health research on policy decisions and health interventions, clear reporting of funding sources is crucial for ensuring trust in the findings, and journal guidelines should make this as mandatory for manuscript authors. Finally, the absence of funding disclosures could reflect a broader issue of insufficient recognition for the role that funding plays in shaping research priorities and outputs. In fact, if funding is not systematically acknowledged, it becomes challenging to trace the influence of different financial sources on the research, which could limit the assessment of publication reliability, and limit stakeholders' ability to make informed decisions about where to allocate resources or how to address gaps in research underfunded fields. However, we consider it unlikely that Italian authors in the public health field may have substantially underreported their sources of funding, given the general requirement of the funders to acknowledge their support, the clear interest of authors to highlight it, and the major ethical and professional (if not even legal) consequences of hiding a funding sources. Overall, therefore, it seems clear that a substantial part of public health research in Italy is performed without a specific research support, and therefore without the need to acknowledge it. This could also make the Italian investigators swifter and more effective in addressing new and rapidly emerging public health issues, given the ability to start research activity even in the absence of specific financial support for it, or before receiving it.

Our assessment may have been hampered by the lack of exhaustive details about the specific grants (such as their codes and numbers) in the acknowledgement section, with consequent risk of indexing errors (especially for publications in languages other than English). Over- or under-representation of funding sources could also vary according to the research topic and its relevance, thus possibly introducing some differential bias.

Other limitations may affect our analysis. We based the evaluation on published papers, not taking into account other kind of publications, e.g. pre-prints, conference papers or grey literature (12). Secondarily, funding acknowledgment does not provide insight on the contributions nor combination or co-usage of researchers' funding, meaning that, when multiple funding sources were used, we could not understand how much a specific fund impacted that publication, also compared with the other sources (50). In addition, the exclusion of papers related to multicenter national and international studies where Italian researchers cannot be clearly identify as having a leading role likely prevented in our study a comprehensive reporting of funding sources for research carried out by Italian investigators, especially in the context of collaborations with EU-entities and International institutions, despite their 'non -primary' responsibility in such research activities. As a consequence, the assessment performed in this study must be considered as applicable only to scientific research in which Italian public health investigators had a clear leading role, either in a national or an international perspective.

We have not contacted researchers, opting instead to scan publications directly. Such approach should not suffer from reporting biases, as could occur by interviewing directly researchers about their current funding, and allow a clear, complete, and standardized approach in funding source mapping (51).

Conclusions

Through this initial screening, we hope to lay the groundwork for more in-depth investigations and discussions about sources, allocation, sustainability and equity of public health research funding in Italy. A better understanding of how funds are distributed across regions and disease categories can help to address disparities and to promote equitable access to research resources, especially in underfunded regions

and institutions and in underserved populations (52). Knowing which institutions or areas of research attract more funding could promote collaboration among regions or institutions with complementary expertise and infrastructure, providing capacity-building support, such as training, infrastructure, or research grants, eventually leading to more sustainable public health systems and more effective public health interventions. In addition, fostering a culture of declaring funding and monitoring the connection between funding and publication output can improve accountability among researchers, promote transparency in research, and ensure the distribution of resources to where they will have the greatest long-term impact under a public health perspective (53). Ultimately, we believe this type of analysis will help in identifying potential biases and funding gaps, and offer opportunities for the improvement of funding strategies, in order to ensure robust and transparent public health research in an EU country such as Italy.

Conflict of interest statement: The authors declare no conflict of interest.

Riassunto

Fonti di finanziamento alla ricerca in Sanità Pubblica in Italia

Introduzione. Le fonti di finanziamento possono avere un impatto cruciale nel definire il panorama della ricerca scientifica in generale, inclusa la Sanità Pubblica, poiché possono influenzare non solo la realizzazione di progetti, ma anche il loro contenuto.

Disegno dello studio. Questo studio ha l'obiettivo di analizzare le attuali fonti di finanziamento per la ricerca in Sanità Pubblica in Italia e le relative implicazioni.

Metodi. Abbiamo condotto una ricerca sistematica su PubMed, coprendo il periodo da gennaio 2023 a giugno 2024. Ci siamo concentrati sulle pubblicazioni dei 208 professori ordinari ed associati in Igiene Generale ed Applicata in servizio presso tutti gli Atenei italiani, includendo solo articoli in cui questi ricercatori fossero primi o ultimi autori, escludendo editoriali, commenti e lettere. Le fonti di finanziamento sono state classificate in: "pubbliche interne", "pubbliche esterne", "private esterne" e "non menzionate".

Risultati. Abbiamo identificato 760 articoli, una volta eliminati i duplicati. I temi di ricerca di tali pubblicazioni sono risultati equamente distribuiti tra malattie trasmissibili (48,2%) e non trasmissibili (51,8%). I finanziamenti pubblici esterni sono risultati i più comuni (33,7%), seguiti da quelli privati esterni (14,3%) e pubblici interni (7,5%), mentre il 58,7% degli studi non ha riportato fonti di finanziamento. La ricerca sulle malattie trasmissibili è stata principalmente sostenuta da fonti private esterne, regionali e dell'Unione Europea, mentre la ricerca sulle malattie non trasmissibili ha ricevuto maggiori finanziamenti da fonti pubbliche esterne, in particolare governative.

Conclusioni. In Italia, il panorama dei finanziamenti per la ricerca in Sanità Pubblica appare complesso, per via del vasto numero di temi trattati e dal frequente intreccio di finanziamenti provenienti da diversi enti. A prescindere dal tema di ricerca, i finanziamenti pubblici risultano più frequenti di quelli privati. Gran parte della ricerca in Sanità Pubblica non sembra tuttavia necessitare di supporti finanziari specifici, suggerendo come le esigenze finanziarie siano spesso contenute. Questo probabilmente offre ai ricercatori di tale disciplina maggiore flessibilità e indipendenza, con importanti implicazioni per la fattibilità degli studi e la riduzione dei conflitti di interesse.

References

1. El-Jardali F, Fadlallah R, Bou Karroum L, Akl EA. Evidence synthesis to policy: development and implementation of an impact-oriented approach from the Eastern Mediterranean Region. Health Res Policy Syst. 2023 Jun 1; **21**(1):40. doi: 10.1186/s12961-023-00989-5. PMID: 37264415; PMCID: PMC10234246.
2. Jit M, Cook AR. Informing public health policies with models for disease burden, impact evaluation, and economic evaluation. Annu Rev Public Health. 2024 May; **45**(1):133-150. doi: 10.1146/annurev-publhealth-060222-025149. Epub 2024 Apr 3. PMID: 37871140.
3. Equator Network. Enhancing the QUAlity and Transparency Of health Research; 2024. Available from: https://www.equator-network.org/. [Last accessed: 2024 October 23].
4. Huang M-H, Huang M-J. An analysis of global research funding from subject field and funding agencies perspectives in the G9 countries. Scientometrics. 2018;**115**(2):833-847. doi: 10.1007/s11192-018-2677-y.
5. Ministry of University and Research. Italian strategy for basic research [Strategia italiana per la ricerca fondamentale]; 2022. Available from: https://www.mur.gov.it/it/news/martedi-19072022/strategia-italiana-la-ricerca-fondamentale-ecco-la-proposta-oltre-il-pnrr. [Last accessed: 2024 October 23].
6. European Union. Researchers across Europe receive €544m in grants from European Research Council; 2023. Available from: https://erc.europa.eu/news-events/news/erc-2022-advanced-grants-results. [Last accessed: 2024 October 23].
7. European Union. Horizon Europe Implementation: Key Figures 2021 – 2023. European Union; May 2024. doi: 10.2777/646835.
8. Lexchin J, Bero LA, Djulbegovic B, Clark O. Pharmaceutical industry sponsorship and research outcome and quality: systematic review. BMJ. 2003 May 31;**326**(7400):1167-1170. doi: 10.1136/bmj.326.7400.1167. PMID: 12775614; PMCID: PMC156458.
9. Lundh A, Lexchin J, Mintzes B, Schroll JB, Bero L. Industry sponsorship and research outcome. Cochrane Database Syst Rev. 2017 Feb 16;**2**(2):MR000033. doi: 10.1002/14651858.MR000033.pub3. PMID: 28207928; PMCID: PMC8132492.
10. Tortorice D, Rappuoli R, Bloom DE. The economic case

for scaling up health research and development: lessons from the COVID-19 pandemic. Proc Natl Acad Sci U S A. 2024 Jun 25;**121**(26):e2321978121. doi: 10.1073/pnas.2321978121. Epub 2024 Jun 17. PMID: 38885387; PMCID: PMC11214072.
11. Vinceti SR, Filippini T. Revising the legislation of Ethics Committees to ease biomedical research in humans across the world: lessons from the COVID-19 emergency. Acta Biomed. 2022 May 11;**93**(2):e2021579. doi: 10.23750/abm.v93i2.12582. PMID: 35546005; PMCID: PMC9171886.
12. Aagaard K, Mongeon P, Ramos-Vielba I, Thomas DA. Getting to the bottom of research funding: acknowledging the complexity of funding dynamics. PLoS One. 2021;**16**(5):e0251488. doi: 10.1371/journal.pone.0251488. PMID: 33979400; PMCID: PMC8115833.
13. Italian National Institute of Statistics (ISTAT). Research and development report in Italy - 2020-2022 [Report ricerca e sviluppo in Italia - 2020-2022]: Italian National Institute of Statistics; 2022. Available from: https://www.istat.it/it/files/2022/09/Report-Ricerca-e-sviluppo-2020-2022.pdf. [Last accessed: 2024 October 23].
14. Larrue P, Guellec D, Sgard F. New trends in public research funding. In: Organisation for Economic Co-operation and Development (OECD), editor. OECD Science, Technology and Innovation Outlook Adapting to technological and societal disruption. Paris: OECD Publishing; 2018. doi: 10.1787/sti_in_outlook-2018-13-en.
15. Lepori B, Jongbloed BWA, Hicks D. Handbook of public funding of research. Cheltenham, UK; Northampton, MA, USA: Edward Elgar Publishing; 2023. PMID: 22919874.
16. Braun D. The role of funding agencies in the cognitive development of science. Res Policy. 1998 Dec;**27**(8):807-821. doi: 10.1016/S0048-7333(98)00092-4.
17. European Commission: Joint Research Centre, Lepori B. Analysis of National Public Research Funding (PREF) – Handbook for data collection and indicators production. Publications Office; 2017. doi: 10.2760/849945.
18. Glaser J, Serrano K. Changing funding arrangements and the production of scientific knowledge: introduction to the special issue. Minerva. 2018 Jan 29;**56**:1-10. doi: 10.1007/s11024-018-9344-6.
19. Italian National Institute of Statistics (ISTAT). Italian statistics yearbook [Annuario statistico italiano]: Istituto Nazionale di Statistica; 2022. Available from: https://www.aranagenzia.it/attachments/article/13572/ASI_2022.pdf. [Last accessed: 2024 October 23].
20. Piovani D, Nikolopoulos GK, Bonovas S. Non-communicable diseases: the invisible epidemic. J Clin Med. 2022 Oct 8;**11**(19):5939. doi: 10.3390/jcm11195939. PMID: 36233805; PMCID: PMC9572583.
21. Wolrd Health Organization (WHO). Global status report on noncommunicable diseases 2010. Geneva, Switzerland: World Health Organization; 2014.
22. Benziger CP, Roth GA, Moran AE. The Global Burden of Disease Study and the Preventable Burden of NCD. Glob Heart. 2016 Dec;**11**(4):393-397. doi: 10.1016/j.gheart.2016.10.024. PMID: 27938824.
23. The Lancet Global Health. Getting to the heart of non-communicable diseases. Lancet Glob Health. 2018 Sep;**6**(9):e933. doi: 10.1016/S2214-109X(18)30362-0. PMID: 30103982.
24. Ministero della Salute. Piano Nazionale della Cronicità. In: Dipartimento della Programmazione, dei Dispositivi Medici, del Farmaco e delle Politiche in favore del Servizio Sanitario Nazionale. Direzione Generale della Programmazione e dell'Edilizia Sanitaria, editors. 2024 ed. Roma; 2024.
25. Robinson JC. Funding of pharmaceutical innovation during and after the COVID-19 pandemic. JAMA. 2021 Mar 2;**325**(9):825-826. doi: 10.1001/jama.2020.25384. PMID: 33443546.
26. Vecchio R, Gentile L, Tafuri S, Costantino C, Odone A. Exploring future perspectives and pipeline progression in vaccine research and development. Ann Ig. 2024 Jul-Aug;**36**(4):446-461. doi: 10.7416/ai.2024.2614. Epub 2024 Mar 1. PMID: 38436081.
27. Filippini T, Zagnoli F, Bosi M, Giannone ME, Marchesi C, Vinceti M. An assessment of case-fatality and infection-fatality rates of first and second COVID-19 waves in Italy. Acta Biomed. 2021 Oct 1;**92**(S6):e2021420. doi: 10.23750/abm.v92iS6.12241. PMID: 34739462; PMCID: PMC8851028.
28. Florio M, Gamba S, Pancotti C. Mapping of long-term public and private investments in the development of Covid-19 vaccines. Eur Parliament COVI Committee. 2023: 1-95.
29. World Health Organization (WHO). An R&D blueprint for action to prevent epidemics. Plan of Action. Geneva: World Health Organization; 2016.
30. Millum J. Should health research funding be proportional to the burden of disease? Politics, Philosophy & Economics. 2023;**22**(1):76-99.
31. Cascini F, Gentili A. National Recovery and Resilience Plan and Health: qualitative analysis on the sustainability of the interventions on healthcare. Ann Ig. 2023 Sep-Oct;**35**(5):602-610. doi: 10.7416/ai.2023.2561. Epub 2023 Mar 3. PMID: 36866601.
32. Kalo Z, van den Akker LHM, Voko Z, Csanadi M, Pitter JG. Is there a fair allocation of healthcare research funds by the European Union? PLoS One. 2019 Apr 15;**14**(4):e0207046. doi: 10.1371/journal.pone.0207046. PMID: 30986207; PMCID: PMC6464186.
33. Filippini T, Vinceti SR. Italian National Recovery and Resilience Plan: a Healthcare Renaissance after the COVID-19 crisis? Acta Biomed. 2021 Nov 17;**92**(S6):e2021463. doi: 10.23750/abm.v92iS6.12339. PMID: 34787594; PMCID: PMC8851004.
34. Mayor S. Global alliance of funders of public health research agrees top priorities. BMJ. 2009 Nov 17;**339**:b4884. doi: 10.1136/bmj.b4884.
35. Ramani-Chander A, Thrift A, van Olmen J, Wouters E, Delobelle P, Vedanthan R, et al. Prioritising and planning scale-up research projects targeting non-communicable diseases: a mixed-method study by the Global Alliance for Chronic Diseases upscaling working group. BMJ Glob Health. 2023 Nov;**8**(11):e012804. doi: 10.1136/bmjgh-2023-012804. PMID: 37963611; PMCID: PMC10649516.

36. World Health Organization (WHO). Draft Fourteenth General Programme of Work (GPW14)(2025–2028). Draft Fourteenth General Programme of Work (GPW14) (2025–2028)2023.
37. Dalla Valle Z, Signorelli C, Renzi C. Primary care doctors retirements in the context of an ageing population in Italy. Ann Ig. 2024 Jul-Aug;**36**(4):392-404. doi: 10.7416/ai.2024.2602. PMID: 38299732.
38. Italian National Institute of Statistics (ISTAT). Populations and households; 2024. Available from: https://www.istat.it/en/population-and-households. [Last accessed: 2024 October 23].
39. European Environment Agency. Indicator AIR003 - Exceedance of air quality standards in Europe; Copenhagen, Denmark: European Environment Agency; 2024. Available from: https://www.eea.europa.eu//publications/europes-air-quality-status-2024. [Last accessed: 2024 October 23].
40. Filippini T, Rothman KJ, Goffi A, Ferrari F, Maffeis G, Orsini N, et al. Satellite-detected tropospheric nitrogen dioxide and spread of SARS-CoV-2 infection in Northern Italy. Sci Total Environ. 2020 Oct 15;**739**:140278. doi: 10.1016/j.scitotenv.2020.140278. Epub 2020 Jun 16. PMID: 32758963; PMCID: PMC7297152.
41. Palandri L, Rizzi C, Vandelli V, Filippini T, Ghinoi A, Carrozzi G, et al. Environmental, climatic, socio-economic factors and non-pharmacological interventions: A comprehensive four-domain risk assessment of COVID-19 hospitalization and death in Northern Italy. Int J Hyg Environ Health. 2024 Oct 3;**263**:114471. doi: 10.1016/j.ijheh.2024.114471. Epub 2024 Jun 6. PMID: 39366078.
42. Daou KN, Hakoum MB, Khamis AM, Bou-Karroum L, Ali A, Habib JR, et al. Public health journals' requirements for authors to disclose funding and conflicts of interest: a cross-sectional study. BMC Public Health. 2018 Apr 23;**18**(1):533. doi: 10.1186/s12889-018-5456-z. PMID: 29688846; PMCID: PMC5913791.
43. Álvarez Bornstein B, Díaz-Faes A, Bordons M. What characterises funded biomedical research? Evidence from a basic and a clinical domain. Scientometrics. 2019 Mar 9;**119**:805-825. doi: 10.1007/s11192-019-03066-3.
44. Grassano N, Rotolo D, Hutton J, Lang F, Hopkins MM. Funding data from publication acknowledgments: coverage, uses, and limitations. JASIST. 2017;**68**(4):999-1017. doi: 10.1002/asi.23737.
45. Wang J, Shapira P. Funding acknowledgement analysis: an enhanced tool to investigate research sponsorship impacts: the case of nanotechnology. Scientometrics. 2011 Mar 5;**87**:563-586. doi: 10.1007/s11192-011-0362-5.
46. National Academies of Sciences Engineering, and Medicine; Policy and Global Affairs; Committee on Science, Engineering, Medicine, and Public Policy; Committee on Responsible Science. Fostering integrity in research. Washington (DC): National Academies Press (US); 2017 Apr 11. doi: 10.17226/21896. PMID: 29341557.
47. Di Federico S, Filippini T, Marchesi C, Vinceti M. Availability of open data related to COVID-19 epidemic in Italy. Ann Ig. 2023 May-Jun;**35**(3):344-358. doi: 10.7416/ai.2022.2514. Epub 2022 Sep 29. PMID: 36178129.
48. Sarli L, Monaco F. Does open data tell us everything? Acta Biomed. 2021 Dec 22;**92**(S2):e2021337. doi: 10.23750/abm.v92iS2.12715. PMID: 35037628.
49. Foundation Open Knowlege. The Open Definition; 2015. Available from: http://opendefinition.org/. [Last accessed: 2024 October 23].
50. Cocos M, Lepori B. What we know about research policy mix. Science and Public Policy. 2020 Apr 1;**47**:235-245. doi: 10.1093/scipol/scz061.
51. Schmutz A, Salignat C, Plotkina D, Devouassoux A, Lee T, Arnold M, et al. Mapping the global cancer research funding landscape. JNCI Cancer Spectr. 2019 Oct 7;**3**(4):pkz069. doi: 10.1093/jncics/pkz069. PMID: 32337488; PMCID: PMC7049992.
52. Lee M, Brandt N, Reyes CE, Mansour D, Maslow K, Sarkisian C. Practical Incorporation of Stakeholder-Informed Ethics into Research Funding Decisions. Prog Community Health Partnersh. 2024;**18**(3):389-396. doi:10.1353/cpr.2024.a937398. PMID: 39308383.
53. Pierson L. Accounting for future populations in health research. Bioethics. 2024 Jun;**38**(5):401-409. doi: 10.1111/bioe.13284. Epub 2024 Apr 11. PMID: 38602177.

Corresponding author: Marco Vinceti, Department of Biomedical, Metabolic and Neural Sciences, University of Modena and Reggio Emilia, Via Campi 287, 41125 Modena, Italy
e-mail: marco.vinceti@unimore.it

ORCIDs:
Riccardo Mazzoli: 0009-0003-2659-8434
Maria La Torre 0009-0002-1812-1102
Vanessa E. Privitera: 0000-0003-3723-2174
Tommaso Filippini: 0000-0003-2100-0344
Marco Vinceti: 0000-0002-0551-2473

SUPPLEMENTARY MATERIAL

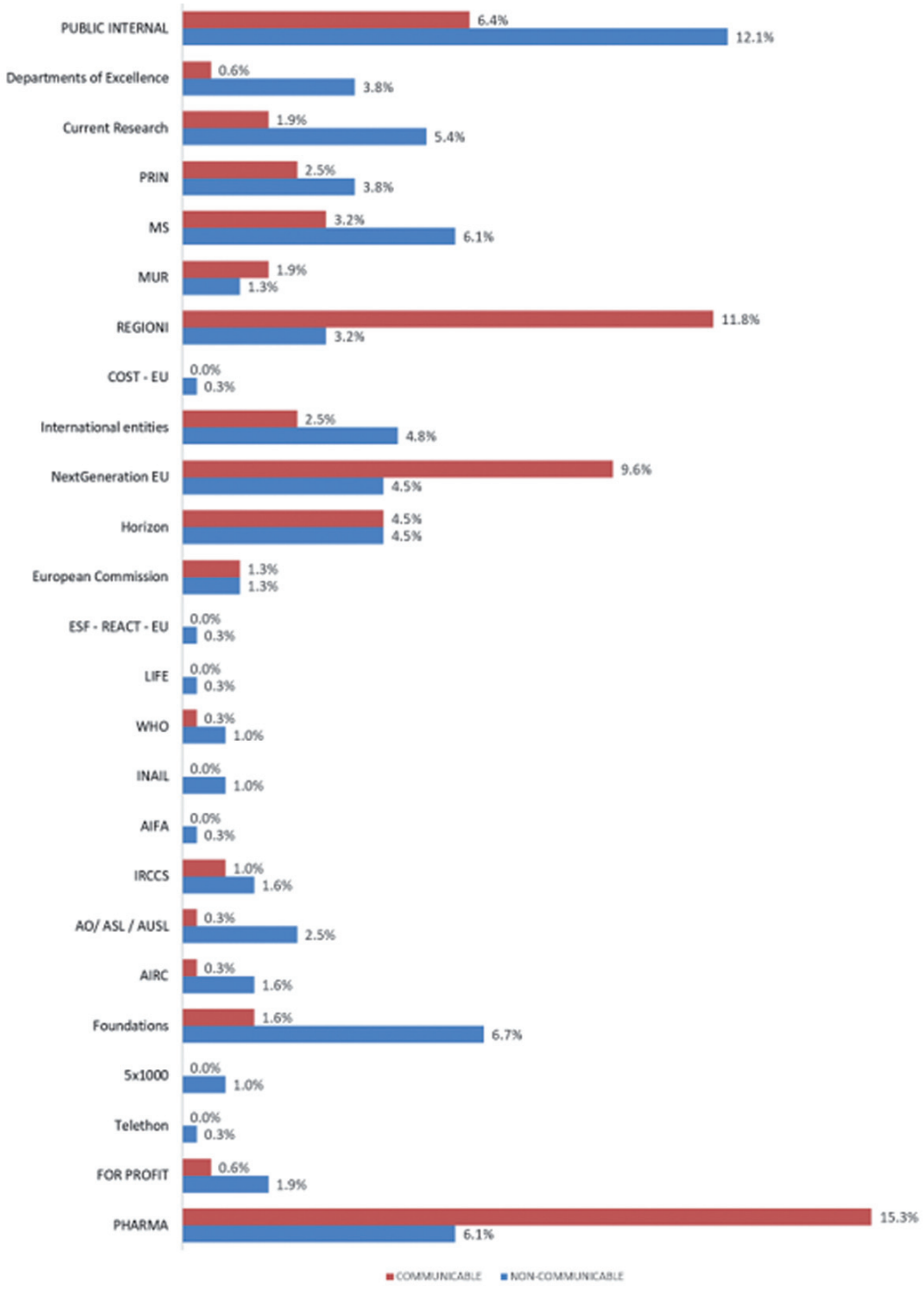
Supplementary Table S1. Main topics of the publications divided into communicable and non-communicable diseases and by geographical area.

	North (n = 342)	Center (n = 176)	South (n = 242)	Total (n = 760)
Communicable diseases	142 (41.5%)	86 (48.9%)	138 (57.0%)	366 (48.2%)
COVID-19	67 (19.6%)	41 (23.3%)	39 (16.1%)	147 (19.3%)
Infectious Disease	40 (11.7%)	21 (11.9%)	53 (21.9%)	114 (15.0%)
Vaccination	28 (8.2%)	21 (11.9%)	32 (13.2%)	81 (10.7%)
HPV	4 (1.2%)	2 (1.1%)	5 (2.1%)	11 (1.4%)
Antibiotic Resistance	3 (0.9%)	1 (0.6%)	9 (3.7%)	13 (1.7%)
Non-communicable diseases	200 (58.5%)	90 (51.1%)	104 (43.0%)	394 (51.8%)
Cancer	36 (10.5%)	7 (4.0%)	14 (5.8%)	57 (7.5%)
CVD	11 (3.2%)	3 (1.7%)	4 (1.7%)	18 (2.4%)
Neurology	11 (3.2%)	10 (5.7%)	2 (0.8%)	23 (3.0%)
Pediatric	15 (4.4%)	3 (1.7%)	4 (1.7%)	22 (2.9%)
Ob&Gyn	3 (0.9%)	1 (0.6%)	3 (1.2%)	7 (0.9%)
Other	124 (36.3%)	66 (37.5%)	77 (31.8%)	267 (35.1%)

Supplementary Table S2. Number of single and multiple sources of funding divided by geographical areas.

	One source of funding	Two sources of funding	Three sources of funding	Four sources of funding
Public Internal	57	-	-	-
North	29	-	-	-
Center	13	-	-	-
South	15	-	-	-
Public External	162	39	4	1
North	75	23	1	1
Center	28	4	2	-
South	59	12	1	-
Private External	105	2	-	-
North	49	1	-	-
Center	34	-	-	-
South	22	1	-	-
Unmentioned	**446**	-	-	-
North	196	-	-	-
Center	103	-	-	-
South	147	-	-	-

Supplementary Figure S1. Detailed sources of funding by type of topic. Values are percentages.



Acronyms: AIFA = Agenzia Italiana del Farmaco (Italian Medicine Agency); AIRC = Associazione Italiana per la Ricerca sul Cancro (Italian Association for Cancer Research); COST = European Cooperation in Science and Technology; CTN = Cluster Tecnologici Nazionali (National Technological Clusters); EFSA = European Food Safety Authority; ESA = European Space Agency; EUPHA = European Public Health Association; FAR = Fondo Ateneo per la Ricerca (University Research Fund); IRCCS = Istituto di Ricovero e Cura a Carattere Scientifico (Scientific Institute for Research, Hospitalization, and Healthcare); ISS = Istituto Superiore di Sannità (National Health Institute); MUR = Ministero dell'Università e della Ricerca (Ministry of University and Research); MS = Ministero della Sanità (Ministry of Health); Pia.ce.ri = Piano di incentivi per la Ricerca di Ateneo (University Research Incentive Plan); PRIN = Progetti di Rilevante Interesse Nazionale (Projects of National Relevance); SItI = Società Italiana Igiene e Medicina Preventiva (Italian Society of Hygiene and Preventive Medicine); WHO = World Health Organization