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PRESENTAZIONE

L'idea di una rassegna degli articoli scientifici pubblicati dai ricercatori su riviste internazionali, peer-reviewed e indicizzate, nasce dalla necessità di dare visibilità a questo tipo di trasferimento dei risultati delle attività di ricerca anche al di fuori della comunità scientifica. Infatti, questa produzione, benché contribuisca significativamente al prestigio dell'Istituto, è difficilmente fruibile al di fuori di un ristretto gruppo di specialisti, in quanto gli argomenti sono molto tecnici, viene pubblicata in lingua inglese e non sempre le riviste sono accessibili gratuitamente. Gli articoli vengono menzionati, solo con la citazione, nei consuntivi annuali dei piani di attività, che hanno però una ben diversa finalità e diffusione.

La raccolta dei lavori pubblicati nel secondo trimestre 2026 consta di 26 articoli nei quali almeno uno degli autori è un ricercatore Inail. La multidisciplinarietà che caratterizza le tematiche affrontate, il cui filo conduttore è sempre la salute e sicurezza del lavoro, rispecchia la natura dei dipartimenti scientifici. Gli articoli selezionati sono pubblicati su riviste indicizzate nelle principali banche dati scientifiche internazionali e sono corredati da indicatori bibliometrici censiti in Web of Science (WoS) e/o Scopus, a garanzia della loro tracciabilità e della valutazione del relativo impatto scientifico secondo gli standard riconosciuti a livello internazionale. L'indice degli articoli è presentato in ordine alfabetico e contiene i collegamenti ipertestuali alle schede riassuntive, che riportano il titolo, i nomi degli autori, l'abstract in inglese, un breve sunto in italiano che ne rende il contenuto fruibile ad un'ampia platea di lettori e il link al full text (nel caso di riviste open access) per consentire la lettura dell'articolo originale a chi sia interessato. Tra gli articoli scientifici pubblicati nel presente numero si segnala *Cytocompatibility of aqueous garlic extract on human cell lines: implications for sustainability utilization*, che valuta la sicurezza biologica di un estratto acquoso di aglio proposto come alternativa naturale ai pesticidi di sintesi. Lo studio, condotto mediante test in vitro su diverse linee cellulari umane rappresentative delle principali vie di esposizione, dimostra che alle concentrazioni compatibili con gli scenari di utilizzo in agricoltura non si osservano effetti citotossici significativi. I risultati supportano l'impiego di estratti vegetali a basso impatto come strumenti per una gestione più sostenibile delle colture, contribuendo al contempo alla riduzione dei rischi per la salute dei lavoratori agricoli e dell'esposizione a sostanze chimiche convenzionali.

Si segnala, inoltre, l'articolo *Characterization of airborne emissions and preliminary in vitro toxicity screening of polyamide 12 used in additive manufacturing*, dedicato alla caratterizzazione delle emissioni aerodisperse generate dall'impiego della poliammide 12 (PA12) nei processi di manifattura additiva. Attraverso un approccio integrato basato sul monitoraggio delle particelle emesse durante la manipolazione delle polveri e le attività di stampa 3D, associato a prove preliminari di tossicità cellulare, il lavoro evidenzia la presenza di particelle aerodisperse correlate alle diverse fasi operative senza rilevare effetti citotossici acuti significativi nelle condizioni sperimentali investigate. Lo studio contribuisce ad accrescere le conoscenze sui potenziali rischi occupazionali associati alle tecnologie additive e sottolinea l'importanza di adeguate misure preventive e di ulteriori approfondimenti in condizioni di esposizione reali.

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ADDITIVE FINGERPRINTING OF AIRBORNE PLASTIC-RELATED PARTICULATE MATTER IN OCCUPATIONAL ENVIRONMENTS: INSIGHTS FROM TARGETED AND UNTARGETED ANALYSIS

Giannelli Moneta B, Balducci C, Santoro S, Perilli M, Pietrodangelo A, Sargolini T, Giusto M, Rossi T, Pomata D, Cerasa M.

SUMMARY

This study aimed to assess the potential of polymer additives as chemical markers of plastic-related emissions in airborne particulate matter in occupational environments, within the broader context of airborne micro- and nanoplastics (MNPs). Particulate matter collected in three facilities, a textile production (FTX), a mineral water bottling plant (FBW) and a tyre service and repair facility (FTR) was investigated to explore the relationship between polymer additives and particulate composition. Samples from multiple sites and size fractions were analysed using a combined targeted and high-resolution untargeted GC-MS approach to characterise plastic additives (e.g. phthalates, alternative plasticisers, antioxidants, UV filters) and related organic compounds. Distinct chemical fingerprints were observed for each facility: FTX was characterised by high-molecular-weight phthalates and terephthalates, with mean concentrations of 5.8 ng/m³ for DEHP and 4.3 ng/m³ for diethyl terephthalate. FBW was dominated by citrate- and adipate-based plasticisers, where acetyl tributyl citrate and di(2-ethylhexyl) adipate showed a mean concentration of 9.4 ng/m³ and 1.7 ng/m³, respectively. FTR showed higher levels of tyre-derived antioxidants and rubber markers, such as tris(2,4-di-tert-butylphenyl) phosphate (mean: 20 ng/m³), 6PPD (3.3 ng/m³), and benzothiazole (1.5 ng/m³). Size-resolved analysis showed enrichment of additives in fine fractions at FTX and in coarse fractions at FTR, reflecting process-specific emission mechanisms. Untargeted screening revealed a complex mixture including auxiliary materials, lubricants, surface treatments and other process-related compounds, providing a comprehensive characterisation of indoor particulate composition. Overall, the results demonstrate that the combined targeted and untargeted chemical profiles reflect site-specific processes and materials, allowing the discrimination of different emission scenarios across the investigated facilities.

BREVE SINTESI

Questo studio ha valutato l'uso di additivi plastici come marcatori chimici di micro- e nanoplastiche aerodisperse (MNP) in tre diversi ambienti di lavoro. Campioni di PM, anche a diversa granulometria, sono stati caratterizzati mediante un approccio combinato GC-MS di tipo targeted e untargeted ad alta risoluzione. Nel complesso, i risultati dimostrano che i profili chimici combinati (mirati e non mirati) consentono di distinguere i diversi scenari di emissione tra le strutture esaminate.

CITAZIONE BIBLIOGRAFICA

Moneta BG, Balducci C, Santoro S et al. Additive fingerprinting of airborne plastic-related particulate matter in occupational environments: Insights from targeted and untargeted analysis. J. Hazard. Mater. 2026;515:143100.

DOI: <https://doi.org/10.1016/j.jhazmat.2026.143100>

ALLERGIC RESPIRATORY DISEASES IN THE CLIMATE CHANGE CONTEXT: AEROBIOLOGICAL TOOLS AND PROJECTIONS AS PREVENTIVE ACTIONS FOR POLLEN-INDUCED ALLERGIES

D'Ovidio MC, Ciardini V, Lancia A, Capone P, Grandi C, Di Rita F, Uda L, Begvarfaj E, D'Isidoro M, Meloni D, D'Elia I, Pace G, di Sarra A.

SUMMARY

Climate change is a global phenomenon with various impacts on human health, in many cases aggravating the effects of pollen allergies. Several studies show the effects of human induced temperature rise and changes in meteorological patterns on pollen production and dispersion, causing earlier flowering onset, extended pollen seasons, and increased pollen production. The repercussions on human health concern both allergic asthma and rhinosinusitis, whose symptoms can be worsened by extended exposure and impacts of extreme meteorological events, such as thunderstorm asthma. In this context, traditional aerobiological monitoring techniques are still valid as staple methods, but with a rising importance of new, automatic real-time sensors and atmospheric pollen forecasting systems, which can be important for early warning and prevention, to reduce and avoid exposure to allergenic pollen during peak days and hours. Omics techniques can also give important information about sensitization and response to allergens, granting a more comprehensive picture of the effects of exposure to allergens. In this paper, we carried out a literature review to discuss all these effects, with a focus on innovative tools and preventive measures. As a result, the application of an integrated and multifactorial approach emerges as fundamental in the management of pollen-induced allergies in the context of climate change.

BREVE SINTESI

Il cambiamento climatico amplifica gli effetti delle allergie al polline, favorendo fioriture anticipate, stagioni polliniche più lunghe e una maggiore produzione e dispersione dei granuli pollinici. Ciò può aggravare asma e rinite allergica. Monitoraggio aerobiologico, sensori automatici, sistemi previsionali e tecniche omiche rappresentano strumenti innovativi per la prevenzione e la gestione delle allergie, attraverso un approccio integrato e multifattoriale.

CITAZIONE BIBLIOGRAFICA

D'Ovidio MC, Ciardini V, Lancia A et al. Allergic respiratory diseases in the climate change context: aerobiological tools and projections as preventive actions for pollen-induced allergies. *Med Sci (Basel)*. 2026;14(4):466.

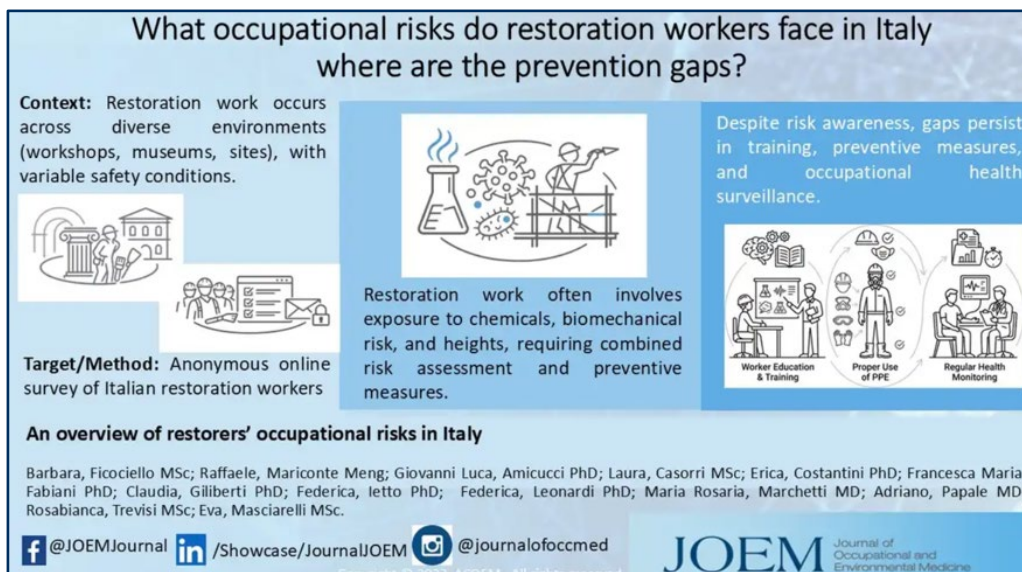
DOI: <https://doi.org/10.3390/medsci14040466>

AN OVERVIEW OF RESTORERS' OCCUPATIONAL RISKS IN ITALY

Ficociello B, Mariconte R, Amicucci GL, Casorri L, Costantini E, Fabiani FM, Giliberti C, Ietto F, Leonardi F, Marchetti MR, Papale A, Trevisi R, Masciarelli E.

SUMMARY

The study aimed to collect general information and assess exposure risks associated with restoration activities in Italy. Data were obtained through an anonymous online survey completed by restorers selected from the cultural



heritage registry published by the Italian Ministry of culture website. The questionnaire collected professional characteristics, and details on perceived risks, preventive measures, and workplace safety conditions. Survey findings indicate that, although participants demonstrate a solid understanding of occupational risks associated with restoration work, there is nevertheless limited attention to health surveillance and inadequate implementation of preventive and protective measures. The findings of this study highlight the critical need to enhance worker education and training on health risks, ensure proper use of personal protective equipment, and promote regular health monitoring.

BREVE SINTESI

Nel presente studio sono state analizzate informazioni generali sulle attività di restauro in Italia acquisite con un questionario online anonimo distribuito ai restauratori iscritti nel registro dei beni culturali (sito web Ministero dei beni culturali). I risultati indicano scarsa attenzione alla sorveglianza sanitaria e inadeguate misure preventive e protettive, mostrando la necessità di migliorare formazione e aggiornamento e promuovere il corretto utilizzo dei DPI e un monitoraggio sanitario regolare.

CITAZIONE BIBLIOGRAFICA

Ficociello B, Mariconte R, Amicucci GL et al. An overview of restorers' occupational risks in Italy. JOEMF. 2026.

DOI: <https://doi.org/10.1097/JOM.0000000000003810>

ARE YOUNGER WORKERS MORE AT RISK? A STUDY ON AGE DIFFERENCES IN OCCUPATIONAL EXPOSURE TO CARCINOGENS

Scarselli A, Corfiati M, Marinaccio A.

SUMMARY

Objective: the aim of this study is to describe the levels of occupational exposure to the most common cancer-causing agents in the Italian industrial context, with a particular focus on age differences to identify high-risk groups of young workers.

Data on exposure to carcinogens were extracted from the national occupational exposures database (SIREP), covering exposure measurements collected between 1996 and 2024. Thirteen carcinogenic agents with over 10,000 recorded measurements were analysed. Exposure intensity was categorised as low, medium, or high according to European regulatory standards. Multinomial logistic and linear mixed-effects regression models, adjusted for gender and calendar period, were used to assess the association between age and exposure level.

A total of 457,291 exposure measurements were selected for the main carcinogens registered in SIREP. Exposed workers (159,582) were only in a small proportion women (9%) and mostly aged between 20 and 44 years in both genders (63% in women, 57% in men). Young people (i.e., under 30) constituted a considerable portion of the total exposed workers (25%) and compared to older workers (≥ 30) had 17.6% higher exposure levels overall, 18.4% in men and 11.2% in women. Age differences in exposure persisted mainly across industries and job categories, but also by gender and nationality.

This study underscores the necessity for targeted preventive strategies, including tailored training programmes, enhanced supervision, and rigorous enforcement of safety protocols for young workers. Improved monitoring and age-specific interventions are essential to reduce occupational cancer risks and safeguard the health of the younger workforce.

BREVE SINTESI

Lo studio analizza 457.291 misurazioni di esposizione a 13 agenti cancerogeni, registrate nel database nazionale SIREP tra il 1996 e il 2024, per valutare le principali differenze legate all'età. I lavoratori sotto i 30 anni rappresentano il 25% degli esposti e presentano livelli medi di esposizione superiori del 17,6% rispetto ai lavoratori più anziani, con un aumento del 18,4% negli uomini e una riduzione dell'11,2% nelle donne. Le differenze variano secondo agente cancerogeno, settore economico, professione, genere e nazione di nascita dei lavoratori. I risultati evidenziano la necessità di interventi preventivi specifici per i giovani, fondati su formazione mirata, supervisione costante, monitoraggio e rigorosa applicazione delle misure di sicurezza.

CITAZIONE BIBLIOGRAFICA

Scarselli A, Corfiati M, Marinaccio A. Are younger workers more at risk? A study on age differences in occupational exposure to carcinogens. *Int Arch Occup Environ Health*. 2026;99(7):46.

DOI: <https://doi.org/10.1007/s00420-026-02238-y>

BIOHYDROGEN PRODUCTION FROM BIOWASTE: HAZOP ANALYSIS APPLIED TO A PILOT-SCALE REACTOR

Lauri R, Valentino F, Incocciati E, Danieli S, Gottardo M.

SUMMARY

This paper focuses on the HAZOP (hazard and operability) analysis applied to a dark fermentation process designed to produce biohydrogen. A pilot reactor for hydrogen production from sludge and the organic fraction of municipal solid waste was studied. With reference to the fermenter (the key process node), operating conditions both maximizing process efficiency and representing the worst-case scenario in terms of process safety have been chosen.

The HAZOP analysis enabled the identification of deviations from normal operating conditions, looking for causes, consequences, and countermeasures, including the effects of microbial community variations on process efficiency. The analysis highlighted significant engineering solutions (gas detectors, temperature and flow transmitters, distributed control system, etc.) aimed at increasing process efficiency while simultaneously enhancing safety levels for operators and the environment.

BREVE SINTESI

L'articolo è stato focalizzato sull'applicazione della metodologia HAZOP ad un impianto pilota, finalizzato alla produzione di bioidrogeno. L'analisi HAZOP ha permesso di evidenziare soluzioni tecniche in grado di migliorare sia l'efficienza che la sicurezza del processo, considerando, in particolar modo, il vasto campo di infiammabilità dell'idrogeno.

CITAZIONE BIBLIOGRAFICA

Lauri R, Valentino F, Incocciati E et al. Biohydrogen production from biowaste: HAZOP analysis applied to a pilot-scale reactor. *Ener.* 2026;9:4194-4212.

DOI: <https://doi.org/10.3390/en19174194>

CHARACTERIZATION OF AIRBORNE EMISSIONS AND PRELIMINARY IN VITRO TOXICITY SCREENING OF POLYAMIDE 12 USED IN ADDITIVE MANUFACTURING

Marcolungo C, Tombolini F, Natale C, Sebastiani F, Ferrante R, Gordiani A, D'Emilia E, Afanou AK, Alswady-Hoff M, Fykerud T, Zienolddiny-Narui S, Bertani R, Sgarbossa P, Boccuni F.

SUMMARY

Polyamide 12 (PA12) is widely used as a feedstock in industrial additive manufacturing (AM), but evidence on possible health effects from occupational exposure remains limited. This study investigated airborne emissions generated by PA12 in two relevant scenarios: laboratory simulation of powder-handling tasks related to powder bed fusion and active filament-based material extrusion 3D printing. A multimetric tiered approach, consistent with OECD recommendations, was applied by combining real-time particle measurements, sample collection for off-line morphological and elemental analyses, and preliminary in vitro toxicity screening of virgin PA12 powder. Particle number concentration, average diameter and lung deposited surface area were monitored during the experiments. Emissions exceeded background levels in both applications. Powder handling mainly released larger micrometric particles, around 20 μm , whereas filament-based extrusion produced smaller aggregates composed of submicrometric components. In vitro tests on human bronchial epithelial cells (HBEC3-KT) showed no significant cytotoxic effects or relevant changes in gene expression after exposure to virgin PA12 powder. Overall, the findings provide useful information for exposure assessment and support the development of precautionary hazard management measures and suitable control strategies for the safe use of PA12-based 3D printing in occupational settings.

BREVE SINTESI

La poliammide 12 (PA12) è un materiale molto usato nella stampa 3D industriale, ma le informazioni sui possibili effetti dell'esposizione professionale sono ancora limitate. Lo studio ha valutato le emissioni aerodisperse prodotte durante la manipolazione di polveri per fusione a letto di polvere e durante la stampa 3D con filamento. Sono state combinate misure in tempo reale delle particelle, analisi morfologiche ed elementari e test preliminari di tossicità in vitro su cellule bronchiali umane. In entrambi gli scenari le emissioni hanno superato i livelli di fondo: la manipolazione delle polveri ha generato soprattutto particelle micrometriche, mentre l'estrusione del filamento ha prodotto aggregati più piccoli. I test non hanno evidenziato effetti citotossici significativi né alterazioni rilevanti dell'espressione genica. I risultati supportano la valutazione dell'esposizione e l'adozione di misure preventive per un uso sicuro della PA12 nei luoghi di lavoro.

CITAZIONE BIBLIOGRAFICA

Marcolungo C, Tombolini F, Natale C et al. Characterization of airborne emissions and preliminary in vitro toxicity screening of polyamide 12 used in additive manufacturing. Environ. Health. 2026.

DOI: <https://doi.org/10.1021/envhealth.6c00320>

CLIMATE CHANGE AND OCCUPATIONAL HEALTH: PERCEPTIONS AND KNOWLEDGE OF HEAT STRESS IN ITALY

Bonafede M, Marinaccio A, Levi M, Pietrafesa E, D'Elia S, Guerri G, Dé Donato F, Massari S, Morabito M, Binazzi A, on behalf of the Workclimate 2.0 collaborative group.

SUMMARY

Adaptation and risk perception are key determinants in mitigating the health impacts of climate change. To guarantee compliance and enable adaptation, it is essential to raise knowledge of risks associated with heatwaves. Within the Italian "Workclimate" project, a survey was conducted in the period 2021 - 2022 providing the first large-scale analysis of heat risk perception and knowledge among Italian workers. Risk perception structure was assessed using principal component analysis; group differences were examined with ANOVA and Chi-square tests, and predictors of heat risk knowledge were identified through multiple linear regression. The study sample consisted of 858 workers. Manual workers, along with those working outside or in settings lacking air conditioning, expressed significantly higher perceived risk compared to other groups, but not corresponding to an adequate level of actual knowledge: over 40% of respondents could not identify the signs of heatstroke or accurately implement emergency actions, and less than 30% knew that heat-related conditions can be fatal. Lack of awareness and the inadequate implementation of measures for mitigating heat stress are associated with factors such as educational level, training, and gender. Moreover, high temperatures were also widely perceived as reducing productivity. The study highlights heat risk as an emerging priority for occupational health and safety in Italy, especially given more common and longer lasting heatwaves. The misalignment between perception and knowledge of risk implies that subjective awareness, without enough training and practical tools, is insufficient to lessen the effects of heat stress on health and productivity.

BREVE SINTESI

Nell'ambito del progetto Workclimate, è stato condotto uno studio su 858 lavoratori italiani. I lavoratori manuali e coloro che operano all'aperto o in ambienti non climatizzati percepiscono il rischio da calore come più elevato, senza però possedere adeguate conoscenze sui suoi effetti sulla salute e sulle misure di mitigazione. La scarsa conoscenza e l'inadeguata adozione di misure preventive risultavano associate a fattori quali livello di istruzione, formazione e differenze di genere. Inoltre, le alte temperature sono state considerate una causa rilevante di riduzione della produttività lavorativa. Il rischio da calore emerge come una priorità crescente per salute, sicurezza e produttività.

CITAZIONE BIBLIOGRAFICA

Bonafede M, Marinaccio A, Levi M et al. Climate change and occupational health: perceptions and knowledge of heat stress in Italy. *Saf Sci.* 2026;200:107245.

DOI: <https://doi.org/doi:10.1016/j.ssci.2026.107245>

CLOSE-TO-CRITICAL HOPF OSCILLATORS BOOST COCHLEAR GAIN IN REALISTIC MODELS WITH FLUID FOCUSING

Sisto R, Moleti A.

SUMMARY

Critical Hopf oscillators have long been proposed as models of cochlear micromechanics and the generation of spontaneous otoacoustic emissions. In these top-down approaches, cochlear active elements are described by abstract equations written in normal form.

The present work addresses this gap through a bottom-up approach. Starting from physically realistic equations describing the main elements of cochlear micromechanics, we demonstrate how a normal-form representation naturally emerges from the underlying dynamics. The Organ of Corti is modeled as two coupled oscillators interacting through an internal active low-pass nonlinear force and coupled to an incompressible two-dimensional fluid.

By deriving the corresponding equations, we generalize the classical two-equation Hopf normal form to a three-equation system. This framework shows that the normal-form approach can accurately describe the relative motion of the principal structures of the Organ of Corti, while the center-of-mass motion is determined solely by fluid forces.

BREVE SINTESI

Gli oscillatori critici di Hopf sono ampiamente utilizzati per descrivere l'amplificazione cocleare, ma i loro parametri hanno spesso un significato puramente matematico. In questo lavoro mostriamo che tali modelli possono essere derivati da una descrizione fisica realistica dell'Organo del Corti, modellato come due oscillatori accoppiati e immersi in un fluido incompressibile. La formulazione ottenuta estende la classica forma normale di Hopf e attribuisce ai suoi parametri un chiaro significato fisiologico, consentendo di quantificare la criticità e le variazioni di guadagno e selettività in frequenza della risposta cocleare.

CITAZIONE BIBLIOGRAFICA

Sisto R, Moleti A. Close-to-critical Hopf oscillators boost cochlear gain in realistic models with fluid focusing. *Hearing Research*. 2026;481:109781.

DOI: <https://doi.org/10.1016/j.heares.2026.109781>

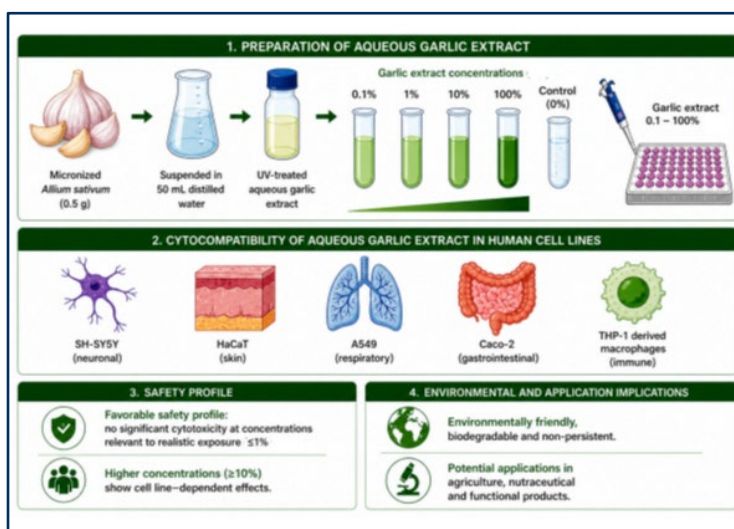
CYTOCOMPATIBILITY OF AQUEOUS GARLIC EXTRACT ON HUMAN CELL LINES: IMPLICATIONS FOR SUSTAINABILITY UTILIZATION

Masciarelli E, Casorri L, Beni C, Valentini M, Reale M, Costantini E.

SUMMARY

Pesticides are widely recognized as hazardous chemicals with potential adverse effects on human health and the environment. Directive 2009/128/EC establishes a framework for the European Union to promote the sustainable use of pesticides and the adoption of alternative agricultural techniques. Specifically, aqueous extracts are complex mixtures of various chemical compounds, such as terpenes, alcohols, aldehydes, and phenols, that have potential herbicidal, insecticidal, and fungicidal properties.

Therefore, they can be used as an alternative to pesticides. This study examined the cytocompatibility of 100, 10, 1 and 0.1% *Allium sativum* L. aqueous extract (ASE) on human cell lines. The aim was to evaluate its effects on viability and cell metabolic activity through in vitro testing to verify the absence of adverse effects for operators who, when using garlic extract in agriculture, may be exposed via dermal contact or inhalation. The results showed that 1 to 0.1% do not significantly affect cell proliferation or viability in all examined cell models, while higher concentrations ($\geq 10\%$) induced cell line-dependent reductions in viability. In summary, the results suggest the potential use of garlic aqueous extract as a potential low-risk alternative to synthetic pesticides and support its safety for occupational exposure of agricultural workers.



BREVE SINTESI

I prodotti fitosanitari sono sostanze chimiche con effetti dannosi sulla salute umana e sull'ambiente. La normativa europea promuove il loro uso sostenibile e l'adozione di tecniche agricole alternative. Tra queste i fitocomplessi sono miscele di composti chimici (terpeni, alcoli, aldeidi e fenoli) con proprietà erbicide, insetticide e fungicide che possono essere utilizzati in alternativa ai prodotti fitosanitari. In questo studio è stata valutata la citocompatibilità del fitocomplesso di aglio su linee cellulari umane per stabilire, con test in vitro, gli effetti su vitalità e attività metabolica cellulare e verificare l'assenza di effetti avversi. I risultati suggeriscono il potenziale impiego del fitocomplesso come alternativa a basso rischio ai prodotti di sintesi per la sicurezza dei lavoratori agricoli.

CITAZIONE BIBLIOGRAFICA

Masciarelli E, Casorri L, Beni C et al. Cytocompatibility of aqueous garlic extract on human cell lines: implications for sustainability utilization. Int. J. Environ. Res. Public Health. 2026;23(8):1056.

DOI: <https://doi.org/10.3390/ijerph23081056>

DETECTION OF CANCER EPIGENETIC ALTERATIONS IN A PILOT COHORT OF WORKERS EXPOSED TO TiO₂

Loi E, Moi L, Floris F, Marongiu A, Valera P, Serra M, Sanjust E, Zavattari C, Tommasi A, Prencipe G, Boccuni F, Gibilras R, Papacchini M, Di Basilio, Zavattari P.

SUMMARY

The extensive use of TiO₂ in several applications raises concerns about its safety. TiO₂ was classified by IARC in 2010 as a Group 2B carcinogen. Since DNA methylation can be influenced by environmental and occupational exposures, this study aimed to investigate cancer-related DNA methylation alterations in workers exposed to TiO₂ in a pigment powder production plant.

Methods: considering inhalation and ingestion as potential exposure routes, we analysed a DNA methylation biomarker associated with lung and colorectal cancers. DNA methylation was assessed by MethyLight in plasma cell-free DNA (cfDNA), comparing workers with different job duties, unexposed healthy controls, and colorectal cancer patients as positive controls. Job-related variables were also considered.

Results: TiO₂-exposed workers showed higher DNA methylation levels than healthy controls, approaching those observed in colorectal cancer patients. The alteration was more pronounced in some occupational categories. The results also highlighted the potential protective role of personal protective equipment: workers using gas masks showed negligible methylation levels compared with the average of their job category.

Discussion: although preliminary, these findings suggest that occupational exposure to TiO₂ particles may alter DNA methylation patterns, potentially contributing to tumorigenesis. They also support the importance of appropriate personal protective equipment and continued monitoring of workers exposed to TiO₂.

BREVE SINTESI

Lo studio ha valutato gli effetti dell'esposizione professionale a TiO₂ sulla metilazione del DNA in lavoratori di un impianto di produzione. I lavoratori esposti hanno mostrato livelli di metilazione superiori ai controlli sani, avvicinandosi a quelli osservati nei pazienti con tumore coloretale. Le alterazioni variavano tra mansioni e risultavano minime nei lavoratori che utilizzavano maschere antigas. I risultati preliminari suggeriscono un possibile ruolo del TiO₂ nell'alterazione epigenetica e sottolineano l'importanza dei DPI e del monitoraggio degli esposti.

CITAZIONE BIBLIOGRAFICA

Loi E, Moi L, Floris F et al. Detection of cancer epigenetic alterations in a pilot cohort of workers exposed to TiO₂. *Front. Toxicol.* 2026.

DOI: <https://doi.org/10.3389/ftox.2026.1901119>

DISSOLUTION AND SURFACE CHEMICAL MODIFICATIONS OF MINERAL FIBRES IN ARTIFICIAL LYSOSOMAL FLUID

Di Carlo MC, Ballirano P, Arrizza L, Montereali MR, Fantauzzi M, Rossi A, Capitani G, Magnani N, Campione M, Yivlialin R, Bussetti G, Campopiano A, Cannizzaro A, Bloise A, Bardelli F, Pettiti I, Pacella A.

SUMMARY

The long-term toxicity of mineral fibres is closely related to their biodurability and surface reactivity, which are in turn strongly influenced by mineral dissolution and surface alteration in lung fluids. We investigated dissolution rates and nanoscale structural, morphological and surface chemical modifications of fibrous antigorite, a non-regulated serpentine polymorph of uncertain pathogenicity, amphibole asbestos (crocidolite and tremolite) and chrysotile, after incubation in artificial lysosomal fluid at pH 4.5, simulating the acidic environment of alveolar macrophages. Fibres were incubated at 37 °C for up to 4 weeks; elemental release was quantified by ICP-OES, and recovered fibres were characterized by PXRD, XPS, FE-SEM, AFM, and TEM. All fibres dissolved incongruently, with preferential leaching of octahedrally coordinated cations and Fe mobilization promoted by citrate complexation. Chrysotile dissolved extensively and became progressively amorphous, consistent with its high specific surface area and preferential removal of Mg from outer octahedral layers. When Si-based dissolution rates are normalised to specific surface area, fibrous antigorite displays biodurability comparable to chrysotile and at least one order of magnitude lower than amphibole asbestos. Among amphiboles, tremolite dissolves more slowly than crocidolite, for which surface erosion exposes underlying Fe(II)-rich layers. Despite the simplified, acellular nature of the ALF model, our results show trends in incongruent dissolution, Fe mobilisation and surface amorphization consistent with in vivo toxicological observations. Integration of ALF-based mineralogical and geochemical data with targeted cellular and in vivo studies may provide a more robust mechanistic framework for understanding the long-term toxicity of both asbestos and currently unregulated fibrous minerals.

BREVE SINTESI

Lo studio ha analizzato come diverse tipologie di fibre minerali, tra cui crisotilo, crocidolite, tremolite e antigorite fibrosa, si modificano in un fluido simulante l'ambiente dei macrofagi polmonari. I risultati ottenuti hanno mostrato che il crisotilo dissolve più rapidamente, mentre gli anfiboli (crocidolite e tremolite), essendo più resistenti, persistono più a lungo nei tessuti. L'antigorite invece presenta un comportamento intermedio. La diversa biodurabilità delle fibre può influenzarne la tossicità contribuendo a spiegare il diverso rischio per la salute umana associato alla loro esposizione.

CITAZIONE BIBLIOGRAFICA

Di Carlo MC, Ballirano P, Arrizza L et al. Dissolution and surface chemical modifications of mineral fibres in artificial lysosomal fluid. *Appl. Geochem.* 2026;209:107048.

DOI: <https://doi.org/10.1016/j.apgeochem.2026.107048>

ENERGY-EFFICIENT OPTIMAL CONTROL OF A WALKING ASSISTIVE ROBOT DRIVEN BY HUMAN MOTION PREDICTION

Fortuna A, Lorenzini M, Motta E, Ranavolo A, De Momi E, Ajoudani A.

SUMMARY

For fragile individuals with motor disabilities or rehabilitation needs, promoting physical activity while ensuring safe support is crucial. In this context, the growing demand for personalized assistance has heightened interest in robotic devices capable of providing adaptive, physically compliant support during walking. This letter presents an innovative control architecture for a walking assistive robot (I-WANDER), designed to aid mobility, provide stability, and prevent falls in individuals with gait difficulties. 15 healthy participants were asked to walk along diverse paths while using the proposed controller and a classical admittance controller (AC). First, we evaluated the prediction model, which significantly outperformed a Kalman-filter method from the literature (p-value < 0.001). Mean trajectory errors were in the centimeter range, thus demonstrating its suitability for real-time control. Subsequently, we compared the combined LSTM-MPC architecture with the AC and found a significant reduction in energy consumption (p-value < 0.001) and improvements in perceived user effort. Overall, the results demonstrate the potential of integrating data-based trajectory prediction with predictive control to infer user intent, enhance human-robot interaction, and improve motion efficiency in assistive walking scenarios.

BREVE SINTESI

Questo studio ha valutato una nuova strategia di controllo per un robot assistivo alla camminata in grado di adattarsi ai movimenti dell'utente. I test hanno mostrato una previsione accurata delle traiettorie di movimento, una riduzione del consumo energetico e un minore sforzo percepito rispetto ai metodi tradizionali. I risultati evidenziano il potenziale di questa soluzione per migliorare sicurezza, stabilità e comfort nelle persone con difficoltà motorie.

CITAZIONE BIBLIOGRAFICA

Fortuna A, Lorenzini M, Motta E et al. Energy-efficient optimal control of a walking assistive robot driven by human motion prediction. IEEE Robot Autom Lett. 2026;11(10):11259-11266.

DOI: <https://doi.org/10.1109/LRA.2026.3723293>

GAIN-DELAY DECOUPLING IN HUMAN STIMULUS FREQUENCY OTOACOUSTIC EMISSIONS REVEALS CONSTRAINTS ON NONLINEAR COCHLEAR AMPLIFICATION

Sharma Y, Moleti A, Sisto R, Botti T, Rodrigo H, Mishra S.

SUMMARY

The nonlinear cochlear amplifier, driven by outer hair cells, is responsible for the remarkable sensitivity and frequency selectivity of mammalian hearing. Stimulus frequency otoacoustic emissions (SFOAEs) provide a noninvasive measure of these active cochlear mechanisms, although the relationship between emission gain and delay across stimulus levels is not yet fully understood. In this study, we investigated the level dependence of SFOAEs in normal-hearing human listeners to characterize cochlear nonlinear response properties. Specifically, we examined how emission gain and delay change with stimulus level and estimated the frequency of the apical-basal transition associated with the breakdown of approximate local scaling symmetry.

BREVE SINTESI

L'amplificatore cocleare non lineare, generato dalle cellule ciliate esterne, è alla base dell'elevata sensibilità uditiva e della selettività in frequenza. In questo studio sono state analizzate le emissioni otoacustiche evocate da toni (SFOAE) in soggetti normoudenti per valutare come guadagno e ritardo dell'emissione varino al crescere del livello di stimolazione e per identificare la frequenza di transizione tra le regioni apicale e basale della coclea.

CITAZIONE BIBLIOGRAFICA

Sharma Y, Moleti A, Sisto R et al. Gain-Delay decoupling in human stimulus frequency otoacoustic emissions reveals constraints on cochlear nonlinear amplification. JARO. 2026.

DOI: <https://doi.org/10.1007/s10162-026-01069-5>

HOW GELLAN GUM GELATION IS AFFECTED BY ACYL SUBSTITUENTS: FROM HIERARCHICAL ORGANIZATION TO SIMPLE VISCOELASTIC BEHAVIOR

Severini L, Tavagnacco L, De Bellis G, Petrella G, Masci G, Casciardi S, Luciani S, Sennato S, Chiessi E, Zaccarelli E, Mazzuca C.

SUMMARY

Gellan gum, a linear anionic exopolysaccharide, is widely employed as a gelling agent owing to its biocompatibility and tunable rheological properties. Its degree of acylation determines high acyl (HA-Gg) and low acyl (LA-Gg) forms, yielding hydrogels with different chemical-physical properties. Rheological measurements show a distinct gelation mechanism: LA-Gg forms rigid, ionically crosslinked networks ($G' \sim 25$ kPa; critical strain $\approx 2\%$) exhibiting two-step yielding, whereas HA-Gg produces softer elastic gels lacking hierarchical organization ($G' \sim 1$ kPa; LVR extends up to $\sim 500\%$ strain). Despite their wide use, the molecular mechanism by which acyl substituents affect Gellan gum gelation is still lacking. Here a comparison between HA-Gg and LA-Gg, combining spectroscopy, rheology, and atomistic molecular dynamics (MD) simulations within a single framework is performed, providing a molecular-level interpretation of these differences. In dilute regime, circular dichroism measurements reveals distinct behavior for LA-Gg and HA-Gg, in coil and double-helix conformations, respectively. MD simulations explain the observed features, showing that acylation enhances intra-helix hydrogen bonding, stabilizing the double-helix structure, while hindering calcium-mediated inter-helix associations. Overall, acylation exerts a dual effect: it strengthens local structural units, but weakening supramolecular connectivity. This interplay governs macroscopic mechanical response, enabling rational design of Gellan gum hydrogels with tailored properties.

BREVE SINTESI

La gomma gellano è un biopolimero capace di formare idrogel con proprietà molto diverse. Lo studio chiarisce che i gruppi acilici rafforzano le doppie eliche del polimero, ma ostacolano i collegamenti mediati dal calcio tra eliche diverse. Nascono così gel più morbidi ed elastici oppure più rigidi e compatti. I risultati aprono la strada alla progettazione di idrogel con caratteristiche su misura.

CITAZIONE BIBLIOGRAFICA

Severini L, Tavagnacco L, De Bellis G et al. How Gellan gum gelation is affected by acyl substituents: from hierarchical organization to simple viscoelastic behavior. Carbohydr. Polym. 2026;389:125606.

DOI: <https://doi.org/10.1016/j.carbpol.2026.125606>

MORTALITY IN AGRICULTURE WORKERS: A CASE-CONTROL STUDY IN ITALY

Gariazzo C, Marinaccio A, Consonni D, Miligi L, Massari S.

SUMMARY

Population working or living in agriculture settings may experience important exposure to pesticides and other agents. We aim to investigate mortality for neurological diseases and cancer in workers employed in agriculture in Italy.

Design: case-control study using mortality data linked with working histories retrieved from the Italian National Social Insurance archive.

Countrywide mortality data from 2005 to 2018 were used. Cases were blue-collar workers with primary/middle school education who died from selected causes; controls were individuals with the same characteristics but died from all other causes. Each participant was assigned to the economic sector in which he/she worked for the longest period. Cause a sex specific mortality odds ratios (MORs) adjusted for age class, educational level, year of death, and region of residence were estimated using logistic regression models in which exposure of interest was "ever/never" in agriculture using the service sectors as (unexposed) reference category.

MORs for causes of death within the groups of mental, behavioral and neurodevelopmental disorders, diseases of the nervous system, and malignant neoplasms.

About 64,000 workers employed in agriculture were included and compared with a control group of 107,000 workers in the service sector. Elevated mortality risk in agriculture workers was found for spinal muscular atrophy (MOR 1.26; 95%CI 1.03 - 1.56) and Parkinson's disease (PD) (MOR 1.16; 95%CI 1.00 - 1.34). As for cancer mortality, positive associations were found for non-follicular lymphoma (NFL) (MOR 1.59; 95%CI 1.03 - 2.46), multiple myeloma (MM) (MOR 1.42; 95%CI 1.22 - 1.65), and myeloid leukemia (ML) (MOR 1.36; 95%CI 1.16 - 1.60), as well as for stomach (MOR 1.30; 95%CI 1.20 - 1.41), prostate (MOR 2.03; 95%CI 1.85 - 2.24), and brain and central nervous system cancer (MOR 1.30; 95%CI 1.13 - 1.50). PD, NFL, ML, cancers of skin, of connective and soft tissue, of prostate and of brain were found to involve mainly men.

Employment in agriculture has been associated with various health risks, some of which may be attributed to pesticides exposure. Their health effects remain of concern.

BREVE SINTESI

Lo studio analizza la mortalità per malattie neurologiche e tumori nei lavoratori agricoli in Italia, usando dati nazionali 2005 - 2018 collegati alle storie lavorative. Sono emersi aumenti di rischio per Parkinson, atrofia muscolare spinale e diversi tumori, suggerendo il possibile ruolo delle esposizioni agricole, inclusi i pesticidi.

CITAZIONE BIBLIOGRAFICA

Gariazzo C, Marinaccio A, Consonni D et al. Mortality in agriculture workers: a case-control study in Italy. *Epidemiol Prev.* 2026;50(3):290-300.

DOI: <https://doi.org/10.19191/EP26.3.A1016.060>

NIR-SWIR HYPERSPECTRAL IMAGING OF POWDER RELEASED FROM SIMULATED WEATHERING OF NOA-BEARING SERPENTINITES: A PILOT INVESTIGATION ON SERPENTINITES FROM TUSCANY (ITALY)

Marzini L, Ciofini D, Agresti J, Azelio Mencaglia A, Disperati L, Marian NM, Valletti N, Viti C, Bellagamba S, Malinconico S, Paglietti F, Siano S, Osticioli I.

SUMMARY

Natural weathering processes, environmental cycles and anthropogenic activities (mining, excavation, road construction) involving naturally occurring asbestos (NOA) materials pose environmental and human health issues due to the potential release of pathogenic fibers. This pilot investigation focuses on the Slake durability test (SDT) to simulate weathering cycles and assess the long-term slaking behaviour of serpentinite samples from Elba Island and the province of Siena (Tuscany, Italy), lithologies commonly hosting asbestos minerals.

The resulting rock powders from the SDT were analysed using a novel portable NIR-SWIR hyperspectral scan imaging tool, enabling rapid detection and mapping of serpentine minerals through their characteristic spectral features.

To validate this results, traditional and complementary FTIR and SEM analyses were performed. This novel approach, combining laboratory engineering-geological analysis and fast NIR-SWIR hyperspectral imaging (HSI) techniques, provided new insights on the durability and the hazard potential (in terms of release index) of serpentinites, while reducing the costs and time-consuming issues of conventional laboratory methods.

BREVE SINTESI

I processi di alterazione naturale, i cicli ambientali e le attività antropiche su materiali con amianto naturale possono favorire il rilascio di fibre pericolose. Lo studio valuta, tramite Slake durability test, le serpentiniti dell'Elba e di Siena, analizzando le polveri con imaging iperspettrale portatile NIR-SWIR e contro verifiche con metodologie analitiche FTIR/SEM, per stimare durabilità e potenziale rilascio in modo rapido ed efficiente.

CITAZIONE BIBLIOGRAFICA

Marzini L, Ciofini D, Agresti J et al. NIR-SWIR hyperspectral imaging of powder released from simulated weathering of NOA-bearing serpentinites: a pilot investigation on serpentinites from Tuscany (Italy). J. Hazard. Mater. Adv. 2026;22:101168.

DOI: <https://doi.org/10.1016/j.hazadv.2026.101168>

ON THE HYDRODYNAMIC BEHAVIOUR OF THE IMMERSED BOUNDARY-LATTICE BOLTZMANN METHOD FOR WETTING PROBLEMS

Bellantoni E, Guglietta F, Demou A, Pelusi F, Um K, Nicolaou M, Desbrun M, Sbragaglia M, Savva N.

SUMMARY

We study the hydrodynamic behaviour of a mesoscale numerical model for wetting dynamics based on the immersed boundary-lattice Boltzmann (IBLB) method. This IBLB model features a wetting potential to capture the interaction between a non-ideal droplet interface and a solid boundary; it is designed to prevent abrupt curvature changes near the contact line.

As this approach prevents direct contact between the droplet and the solid, it forms a thin film beneath the droplet, which could compromise the hydrodynamic consistency in this region.

This paper presents detailed comparisons against two other hydrodynamic solvers, respectively based on a boundary element method (BEM) and a volume of fluid (VoF) method, in order to examine the hydrodynamic behaviour of this IBLB scheme, elucidate its limits of validity in wetting applications, and explore the properties of its contact-line model.

BREVE SINTESI

Lo studio analizza come una goccia si espande e cambia forma su una superficie, mostrando che il modello sviluppato descrive correttamente anche le fasi più dinamiche.

Questo tipo di simulazione può essere utile per studiare materiali soffici, rivestimenti e processi in cui l'interazione tra liquidi e superfici è importante, con possibili ricadute anche nell'analisi di fenomeni di interesse tecnologico e occupazionale.

CITAZIONE BIBLIOGRAFICA

Bellantoni E, Guglietta F, Demou A et al. On the hydrodynamic behaviour of the immersed boundary-lattice Boltzmann method for wetting problems. EPL. 2026;155(6):63002.

DOI: <https://doi.org/10.1209/0295-5075/ae92af>

OPTIMIZING SPECIFIC DARK FERMENTATION STRATEGIES FOR ENHANCED BIO-HYDROGEN PRODUCTION FROM DIFFERENT AGRICULTURAL WASTES

Bertasini D, Valentino F, Lauri R, Bolzonella D, Battista F.

SUMMARY

The integration of the dark fermentation process into existing anaerobic digestion plants, leading to the implementation of two stage processes, may enable the sequential recovery of biohydrogen and biomethane from agricultural residues.

This study evaluated semi-continuous dark fermentation of cattle manure, corn residue and soybean residue at hydraulic retention times of 3–10 days, including co-fermentation and digestate recirculation strategies.

BREVE SINTESI

L'articolo ha esaminato la potenzialità, ai fini della produzione di bioidrogeno, di alcuni residui agricoli, evidenziando alcuni aspetti di sicurezza, che devono essere esaminati in tale processo produttivo.

CITAZIONE BIBLIOGRAFICA

Bertasini D, Valentino F, Lauri R et al. Optimizing specific dark fermentation strategies for enhanced bio-hydrogen production from different agricultural wastes. *Renew. En.* 2026;275:1-10.

DOI: <https://doi.org/10.1016/j.renene.2026.126281>

PREVENTING WORKPLACE AGGRESSION THROUGH A MULTI-ACTOR PERSPECTIVE: BRIDGING THE GAP BETWEEN EVIDENCE AND PUBLIC POLICIES

Fida R, Evans L, Salh S, Barbaranelli C, Ghelli M, Ronchetti M.

SUMMARY

Background: despite extensive research on workplace aggression, far less attention has been paid to how regulatory frameworks structure its prevention and management. Although national policies establish legal duties and guidance, it remains unclear how prevention is conceptualised, how responsibilities and interventions are articulated for different actors (perpetrators, targets and bystanders), and the extent to which policy aligns with contemporary evidence.

Aims and objectives: this study conducts a systematic policy mapping review of UK statutory and non-statutory documents addressing workplace aggression. Using a multi-actor, multi-level prevention framework, we examine how policies define workplace aggression, structure monitoring, and distribute primary, secondary and tertiary prevention across perpetrators, targets, and bystanders.

Findings: we screened 8,413 documents and analysed 57 eligible policies. The mapping reveals a fragmented policy landscape characterised by definitional inconsistencies, uneven monitoring guidance, limited attention to digital forms of aggression and an imbalanced prevention portfolio. Prevention efforts are comparatively concentrated on targets and post-incident responses, with limited articulation of bystander-focused and tertiary strategies, and relatively little structured primary prevention targeting perpetrators beyond normative statements such as zero-tolerance. These patterns suggest a predominantly reactive orientation within current policy approaches.

Discussion and conclusion: by systematically applying a multi-actor framework across the full policy corpus, this study moves beyond descriptive review to provide a diagnostic account of prevention coverage within a mature regulatory system. The framework offers a practical tool for policy makers and organisations to audit gaps, strengthen prevention portfolios and stage implementation.

BREVE SINTESI

L'articolo analizza come le politiche del Regno Unito affrontano aggressioni e violenze sul lavoro. Dalla revisione di 57 documenti emerge un quadro frammentato, spesso più reattivo che preventivo. Gli autori propongono un approccio multi-attore per rafforzare prevenzione, monitoraggio e responsabilità condivise.

CITAZIONE BIBLIOGRAFICA

Fida R, Evans L, Salh S et al. Preventing workplace aggression through a multi-actor perspective: bridging the gap between evidence and public policies. *Evid Policy*. 2026;13:1-26.

DOI: <https://doi.org/10.1332/17442648Y2026D000000100>

QUANTITATIVE CLASSIFICATION OF ASBESTOS-LIKE MORPHOLOGY FOR ASSESSING POTENTIALLY HAZARDOUS FIBROUS MINERALS

Petriglieri JR, Barale L, Tomatis M, Cavallo A, De Giulia C, Bruno MR, Olori A, Bruni BM, Ballirano P, Belluso E, Piana F, Pacella A, Campopiano A, Turci F.

SUMMARY

Hazard assessment of naturally occurring asbestos and asbestos-like minerals (NOA) is hindered by the lack of standardized criteria for quantifying asbestos-like morphology. This work introduces the fibrosity parameter (Fp), an experimental approach for classifying suspected fibrous minerals. Fp combines standardized mechanical stress with automated morphometric analysis to evaluate changes in the percentage of elongate mineral particles (EMP) during milling. The approach was tested on five antigorite and three tremolite samples spanning fibrous, lamellar, and prismatic morphologies, using crocidolite, amosite, MMVF, and talc as references. Fp is defined by EMP% after 20 min of milling (EMP20%) and the slope of EMP% between 2 and 20 min (S). Thresholds of EMP20% = 50% and S = 1 distinguished four morphological scenarios: 1) asbestos or asbestos-like, 2) precautionary asbestos-like, 3) non-asbestos-like, and 4) non-asbestos. Fibrous antigorite samples and one tremolite retained high EMP contents and behaved comparably to asbestos references, whereas another macroscopically fibrous tremolite progressively lost fibrosity and was classified as non asbestos-like. Thus, macroscopic fibrosity is not a reliable proxy for asbestos-like fragmentation behaviour. Fp provides a quantitative and reproducible morphological screening tool that complements broader hazard assessment. However, Fp is not a stand-alone predictor of pathogenicity.

BREVE SINTESI

Ad oggi mancano criteri standardizzati che consentano la classificazione dei minerali sospetti di essere fibrosi. A tal fine il presente lavoro introduce il parametro di fibrosità, Fp, un approccio sperimentale per la quantificazione della capacità del minerale fibroso di produrre fibre. Sulla base di questo parametro, i minerali fibrosi possono essere classificati in quattro scenari morfologici: 1) amianto o simile all'amianto, 2) simile all'amianto a titolo precauzionale, 3) non simile all'amianto e 4) non amianto. Lo studio evidenzia come la fibrosità macroscopica non sia un indicatore affidabile del comportamento di frammentazione simile all'amianto. L'Fp (Fibrosity parameter) costituisce uno strumento di screening morfologico quantitativo e riproducibile che integra una valutazione più ampia del rischio pur non essendo un predittore autonomo di patogenicità.

CITAZIONE BIBLIOGRAFICA

Petriglieri JR, Barale L, Tomatis M et al. Quantitative classification of asbestos-like morphology for assessing potentially hazardous fibrous minerals. *J Hazard Mater.* 2026;516:143415.

DOI: <https://doi.org/10.1016/j.jhazmat.2026.143415>

RISK OF EMPLOYMENT SEPARATION AMONG WORKERS WITH HEAD AND NECK CANCER: A LONGITUDINAL COHORT STUDY IN TURIN

Farina E, Licitra L, Mercalli F, Massari S, Marinaccio A, Gariazzo C, Taiano L, Foggetti R, Zengarini N, Trama A and BD4QoL working group.

SUMMARY

Purpose: returning to work after cancer offers important psychological and economic benefits. However, individuals with head and neck (H&N) cancer face a higher risk of leaving the workforce due to the functional consequences of treatments. This study examined the association between H&N cancer and job separation within 2 years of diagnosis and identified patient profiles at higher risk.

Methods: an integrated database was created by linking the Turin longitudinal study, the regional Mandatory communications archive, and the national Inps archive. Incident H&N cancer cases were identified through hospital discharge records, and employment status was defined using occupational data. Each worker with H&N cancer was matched with four cancer-free workers of similar sociodemographic characteristics (non-cases).

Patient profiles were defined through latent class analysis. Robust Poisson models were used to estimate the risk of job separation.

Results: between 2008 and 2020, 255 employed individuals were diagnosed with H&N cancer. They showed a twofold higher risk of job separation compared with matched non-cases (RR = 2.00, 95% CI: 1.59 - 2.51). Some profiles were more likely to exit the workforce, particularly workers with more severe disease (RR = 2.14, 95% CI: 1.04 - 4.42) or with lower education and higher socioeconomic deprivation (RR = 1.74, 95% CI: 1.02 - 2.95).

Conclusions: H&N cancer diagnosis substantially increases the likelihood of job separation, particularly among socioeconomically disadvantaged workers.

BREVE SINTESI

Il tumore testa-collo aumenta significativamente il rischio di uscita dal lavoro entro due anni dalla diagnosi. Lo studio, basato su dati longitudinali e occupazionali, mostra un rischio doppio rispetto ai lavoratori senza tumore, soprattutto nei casi più gravi e tra soggetti con minore istruzione e maggiore svantaggio socioeconomico.

CITAZIONE BIBLIOGRAFICA

Farina E, Licitra L, Mercalli F et al. Risk of employment separation among workers with head and neck cancer: a longitudinal cohort study in Turin. *Support Care Cancer*. 2026;34(8):797.

DOI: <https://doi.org/10.1007/s00520-026-11011-3>

SCROLLING AWAY FROM OUR INSECURITY. THE MEDIATING ROLE OF AFFECTIVE JOB SATISFACTION IN THE RELATIONSHIP BETWEEN JOB INSECURITY AND CYBERLOAFING

Spinella F, Marzocchi I, Ghezzi V, Fusco L, Olivo I, Isolani S, Barbaranelli C.

SUMMARY

Cyberloafing, namely the use of the Internet during working hours for personal purposes, has gained increasing popularity in literature; however, the underlying job stressors and processes driving its occurrence remain insufficiently understood.

Drawing on the Conservation of resources theory and the Social exchange theory, the present study extends this literature by examining whether a critical contemporary job stressor (i.e. job insecurity) influences the tendency to engage in cyberloafing. Although job insecurity has the inner potential to both facilitate and inhibit the occurrence of cyberloafing (as an attempt to secure one's employment), we suggest affective job (dis)satisfaction as a potential explanatory mechanism through which job insecurity may facilitate this withdrawal behaviour.

A sample of 426 Italian employees (62.7% female) completed an online survey in two waves with a one-month lag. The findings reveal that job insecurity operates as a resource-draining and emotion-inducing condition that indirectly contributes to increased cyberloafing by diminishing affective job satisfaction. Our study provides new insights into the job – and individual-related mechanisms that affect cyberloafing, highlighting the crucial role of job insecurity and its emotional consequences in shaping this digitally mediated employee behaviour.

BREVE SINTESI

Lo studio analizza il ruolo dell'insicurezza lavorativa nel favorire il cyberloafing, ossia l'uso di Internet per fini personali durante l'orario di lavoro. Su un campione di 426 lavoratori italiani, i risultati mostrano che l'insicurezza lavorativa aumenta indirettamente il cyberloafing attraverso una riduzione della soddisfazione affettiva lavorativa, evidenziando il ruolo delle conseguenze emotive dell'insicurezza nei comportamenti di ritiro digitale.

CITAZIONE BIBLIOGRAFICA

Spinella F, Marzocchi I, Ghezzi V et al. Scrolling away from our insecurity. The mediating role of affective job satisfaction in the relationship between job insecurity and cyberloafing. *Behav Inf Technol.* 2026;1-16.

DOI: <https://doi.org/10.1080/0144929X.2026.2716293>

SEASONALITY AND ENVIRONMENTAL DETERMINANTS OF EXHALED NITRIC OXIDE IN INDIVIDUALS WITH AND WITHOUT CHRONIC RESPIRATORY DISEASES

Torroni L, Locatelli F, Marchetti P, Baldacci S, Gariazzo C, Maio S, Silibello C, Spiteri G, Stafoggia M, Viegi G, Verlato G, Marcon A on behalf of the BIGEPI group.

SUMMARY

Fractional exhaled nitric oxide (FeNO) is a biomarker of type-2 lung inflammation. Standardized measurement is essential for accurate diagnosis and monitoring. We assess seasonality and environmental determinants of FeNO in individuals with and without chronic respiratory diseases in the general population.

This is a cross-sectional study on 412 individuals with chronic respiratory diseases (asthma, chronic bronchitis/chronic obstructive pulmonary disease, rhinitis) and 605 individuals without these conditions. Participants, aged 20 – 65 years, were recruited in the gene-environment Interactions in respiratory diseases study in Verona, Italy (2008 – 2014). Geocoded residential addresses were linked to daily PM₁₀ and air temperature at the time of the clinical examination using previously developed spatiotemporal models. Associations with log-FeNO were analyzed using adjusted linear regression, accounting for seasonality and disease status.

FeNO levels were higher in subjects with respiratory diseases during the warm season, even after adjusting for pollen exposures; a milder seasonal pattern was observed in subjects without chronic respiratory diseases (P for interaction = 0.001). A 10 µg/m³ increase in mean PM₁₀ concentration at lag 0–1 (day of FeNO measurement and day before) was associated with a 3% higher FeNO concentration (ratio of geometric means, RGM: 1.03, 95% confidence interval: 1.00, 1.06) after adjusting for seasonality.

FeNO is a sensitive biomarker of environmental exposures. Overlooking seasonality and environmental factors might impact clinical decision-making in chronic respiratory diseases.

BREVE SINTESI

La frazione di ossido nitrico esalato (FeNO), indicatore di infiammazione respiratoria di tipo 2, varia in funzione della stagione e dell'esposizione ambientale. I livelli di FeNO risultano più elevati nei soggetti con malattie respiratorie croniche durante la stagione calda. Anche l'esposizione a PM₁₀ nei giorni immediatamente precedenti la misurazione è associata a un aumento del FeNO. I risultati evidenziano l'importanza di considerare fattori stagionali e ambientali nell'interpretazione clinica del biomarcatore.

CITAZIONE BIBLIOGRAFICA

Torroni L, Locatelli F, Marchetti P et al. Seasonality and environmental determinants of exhaled nitric oxide in individuals with and without chronic respiratory diseases. *Environ Epidemiol.* 2026;10(4):e501.

DOI: <https://doi.org/10.1097/EE9.0000000000000501>

THE IMPACT OF CROSSABLE DANGER TACTILE GROUND INDICATORS ON THE CENTER OF MASS AND REACTION FORCES DURING WALKING OF HEALTHY SIGHTED SUBJECTS

Tatarelli A, Varrecchia T, Silvetti A, Fiori L, Chini G, Ranavolo A.

SUMMARY

Pedestrian distraction from smartphone use has become a serious safety hazard in urban areas.

Traditional safety systems, such as raised crosswalks, smartphone apps, and intelligent alarm systems, have limits in terms of cost, maintenance, accessibility, and effectiveness. Tactile ground indicators, which were originally created to help blind and visually impaired pedestrians, may be a simple and effective solution since they provide mechanical stimuli that can induce sensorimotor responses in distracted walkers.

The purpose of this study was to analyze the kinematic and kinetic effects of tactile ground indicators in M-PVC-P technopolimer on gait in healthy sighted people to determine their potential as passive haptic alert systems.

Sixteen healthy individuals walked across two tactile codes, "crossable danger" and "attention" codes, as well as a straight tactile paving (control). Gait kinematics and kinetics were measured with a stereophotogrammetric motion capture system and dynamometric platforms. The center of mass displacement and ground reaction forces were investigated and statistically compared.

Walking over both tactile codes resulted in a significant increase in medio-lateral center of mass displacement compared to the control path. The vertical ground reaction force and its two peaks were much lower on tactile codes, indicating a more cautious and adaptable stride pattern. The "attention" code reduced antero-posterior force displacement and increased medio-lateral displacement.

Mechanical disturbances caused by tactile ground indicators affect gait dynamics in healthy individuals, activating postural control mechanisms. These findings show that tactile surfaces could be used as low-cost haptic alert systems to improve pedestrian awareness, particularly among smartphone-distracted walkers.

BREVE SINTESI

L'uso dello smartphone durante la camminata rappresenta un rischio crescente per la sicurezza dei pedoni. Questo studio ha valutato gli effetti di indicatori tattili a terra su andatura ed equilibrio in 16 soggetti sani. I risultati mostrano che tali superfici modificano la dinamica del passo, attivando meccanismi di controllo posturale e inducendo una camminata più prudente. Gli indicatori tattili potrebbero quindi costituire un sistema aptico passivo, semplice ed economico, per aumentare l'attenzione dei pedoni distratti.

CITAZIONE BIBLIOGRAFICA

Tatarelli A, Varrecchia T, Silvetti A et al. The impact of crossable danger tactile ground indicators on the center of mass and reaction forces during walking of healthy sighted subjects. *Traffic Inj Prev.* 2026;1–7.

DOI: <https://doi.org/10.1080/15389588.2026.2714312>

THE PROVISION OF PSYCHOLOGICAL CARE FOR PATIENTS WITH MESOTHELIOMA AND THEIR CAREGIVERS: AN ITALIAN SURVEY

Granieri A, Franzoi IG, Sauta MD, Barbagli F, Mensi C, Marinaccio A, Bonafede M.

SUMMARY

Background: mesothelioma is a rare, aggressive tumor that profoundly affects patients and caregivers. However, few studies address psychological interventions for this population, either nationally or internationally. This study therefore aims to map the current state of psychological care provided by the regional operating centers. (CORs) of the Italian National mesothelioma registry and other health and welfare facilities in Italy.

The survey lasted approximately 15 min.

The final sample includes 15 CORs and 57 other facilities. Among them, 66.7% (n = 10) of CORs and 5.3% (n = 3) of other facilities lack a psychologist. Only one COR includes a psychologist at diagnosis, compared to 12.9% of other facilities. Psychological interventions are offered by only 25% of all centers. Where psychologists are present, 100% of respondents consider them useful; in their absence, 45.5% of CORs and all other facilities consider their inclusion valuable. Interventions for mesothelioma patients and families are provided in two of four CORs and in 37 of 52 other facilities with a psychologist. In seven facilities, interventions target only patients, and in three, they are specific to this population of patients and caregivers.

Although national and international guidelines emphasize the importance of interdisciplinary care for mesothelioma patients and their families, many still lack adequate support. Closing this gap is urgent, as most healthcare professionals recognize the value of such integration-both when they experience it and when it is absent in their workplace.

BREVE SINTESI

Lo studio presenta i risultati di una survey per l'analisi dei servizi di supporto psicologico forniti dai centri operativi regionali (COR) del Registro nazionale dei mesoteliomi (ReNaM) ai pazienti ed ai loro familiari. I risultati mostrano l'insufficiente distribuzione di questo servizio nelle Regioni e confermano la necessità di integrare l'analisi della sofferenza emotiva nei pazienti e di definire strumenti di intervento.

CITAZIONE BIBLIOGRAFICA

Granieri A, Franzoi IG, Sauta MD et al. The provision of psychological care for patients with mesothelioma and their caregivers: an Italian survey. *Front Public Health*. 2026;14:1879469.

DOI: <https://doi.org/10.3389/fpubh.2026.1879469>

WEARABLE-ONLY ESTIMATION OF L5-S1 JOINT MOMENTS DURING LIFTING: A CEINMS-BASED VALIDATION

Motta F, Refai MI, Ranavolo A, Varrecchia T, Sartori M and Galli M.

SUMMARY

This study aimed to evaluate the use of wearable sensors to estimate L5-S1 flexion moments during symmetric lifting tasks by integrating inertial motion capture (IMC), surface electromyography (sEMG), and the calibrated EMG informed neuromusculoskeletal (CEINMS) framework.

Eight participants performed stoop and squat lifting at four load levels while gold-standard optoelectronic motion capture, ground reaction forces, inertial measurement units (IMUs), and sEMG were recorded. IMC-based inverse dynamics showed excellent agreement with OMC ($p = 0.83 - 0.96$; $ICC > 0.91$), with mean errors around 2 - 3 Nm. CEINMS moments calibrated using wearable data exhibited strong reliability and captured the expected load-dependent increases in lumbar moments, although peak values during heavy lifting were systematically underestimated. IMC consistently underestimated L5-S1 flexion angles by 2° , likely contributing to the reduced peak moment estimates. Overall, findings support the feasibility of a wearables-only approach for ergonomic risk assessment. Future work should focus on improving lumbo-sacral flexion angle estimation from IMUs, potentially through multi-sensor lumbar configurations.

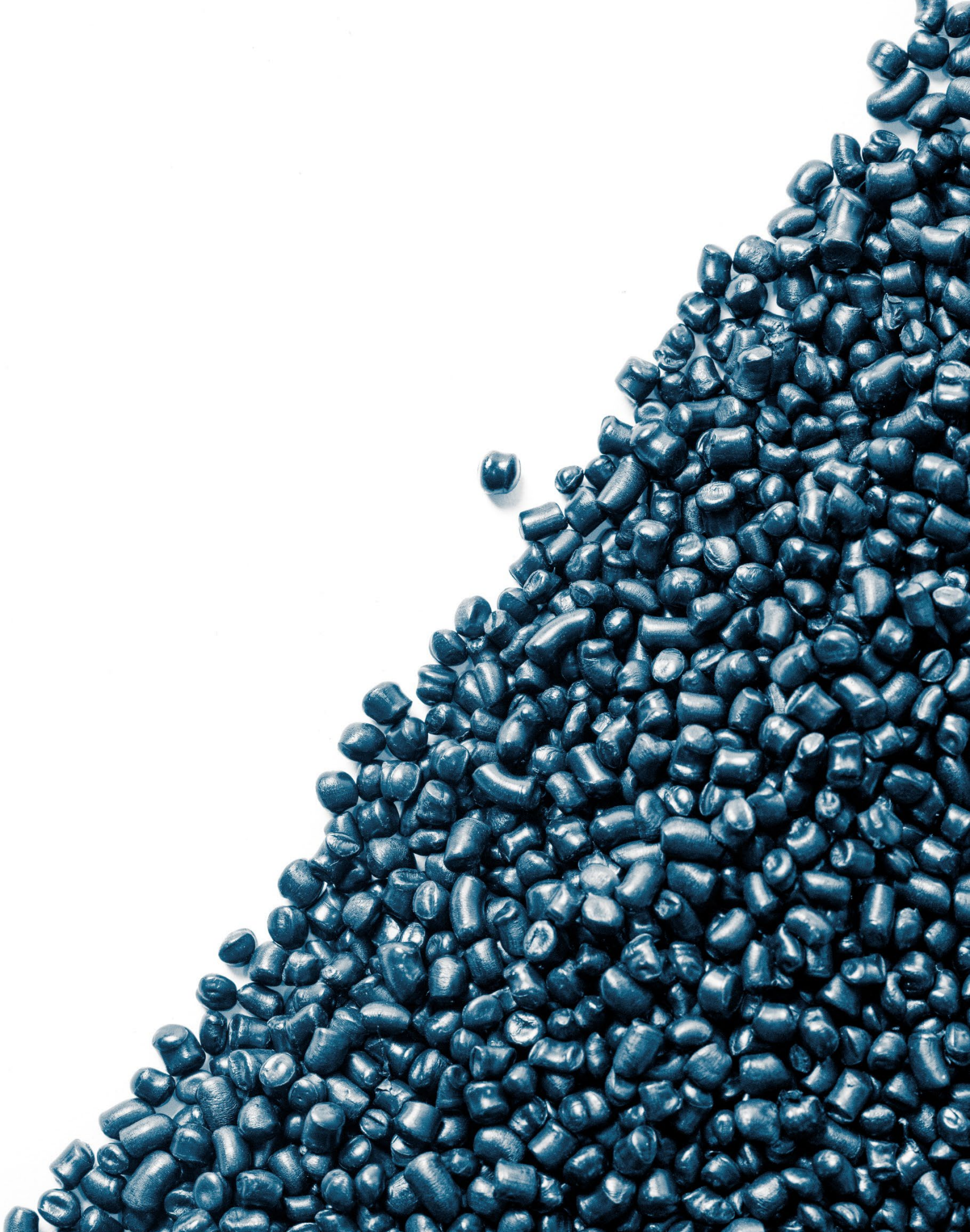
BREVE SINTESI

Lo studio ha dimostrato che sensori indossabili, combinando sensori di movimento e attività muscolare, possono stimare in modo affidabile il carico biomeccanico sulla zona lombare durante il sollevamento di pesi. I risultati mostrano una buona accuratezza rispetto ai sistemi di laboratorio, confermando il potenziale di questi strumenti per valutare il rischio ergonomico direttamente nei luoghi di lavoro. Restano però margini di miglioramento nella stima dei movimenti lombari più ampi.

CITAZIONE BIBLIOGRAFICA

Motta F, Refai MI, Ranavolo A et al. Wearable-only estimation of L5-S1 joint moments during lifting: a CEINMS-based validation. *Wearable Technol.* 2026;7:e12.

DOI: <https://doi.org/10.1017/wtc.2026.10047>



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