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## Open magnetic resonance systems and their role in a changing world technologies

Fujifilm's open magnetic resonance systems are a response to a changing society – in Europe and in the whole world. There are more and more of us, we are getting older, we are getting fatter, we have more and more physical and mental health problems. How to provide adequate medical care to an increasing number of patients with special requirements? Patients with obesity, for whom the standard closed system is "too small", patients with claustrophobia who run away from the room just after looking at the "tunnel", or elderly patients for whom the comfort of the examination, the possibility of contact with somebody during the procedure is the most important. The increasing availability of MR examination means that children are increasingly referred to this examination. These are groups that, although often overlooked and treated as niche, will constitute a growing percentage of patients in MR systems.

Aging is an European and global trend – since 1950 the number of people in their sixties has tripled. Forecasts predict that in 2050 more than 2 trillion people on our planet will be seniors. And Asia and Europe are the leaders in these statistics - 28% of Japanese are people over the age of 65, followed by Italy - 23%, followed by Finland, Portugal, and Greece.



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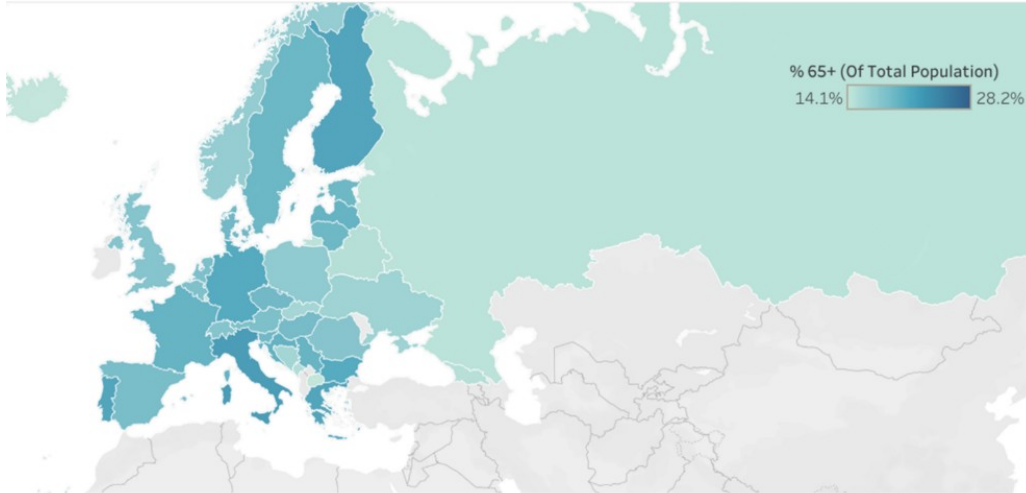
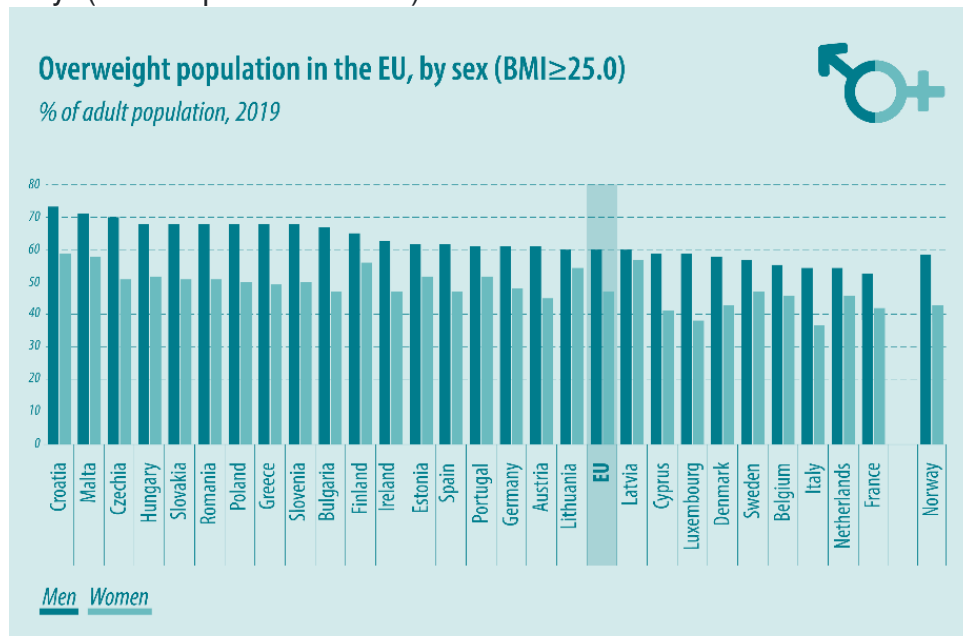


Figure 1 Percentage share of people aged 65+ in Europe

We are also getting fatter; unfortunately, it is also a global trend. In Europe, the first place in this infamous statistic belongs to Croatia, and in the last place is France. In all European countries, men are statistically more obese than women, with the smallest gender difference in Lithuania and Latvia, the largest in Luxembourg and Italy. ([ec.europa.eu/eurostat](http://ec.europa.eu/eurostat)).



[ec.europa.eu/eurostat](http://ec.europa.eu/eurostat)

Figure 2 Percentage share of people with obesity in Europe



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Obesity among children is a particular problem – in the last 40 years the number of obese children has increased 10-fold. This is an alarming trend, called a time bomb. Currently, children are diagnosed with type 2 diabetes, once known only in adults. The WHO estimates the number of children in Europe diagnosed with extreme obesity (BMI  $\geq 40$ ) at 800,000. (1)

Claustrophobia is a less important problem – there is no special society or magazine dedicated to claustrophobia, as in the case of obesity or aging. However, it is estimated that in almost 25% of patients referred for an MRI study, they experience some type of phobia (2). Between 2 and 5% of patients do not complete the study in the closed system due to claustrophobia (3). Most radiologists, clinicians and technicians will simply offer sedation for the duration of the MRI examination. But there are other ways to support claustrophobic patient to go through an MR procedure without the need for pharmacological intervention.

Pediatric patients are most often found in specialized MR centers. But growing availability and request for magnetic resonance imaging and its various applications mean that in smaller MR sites a young patient with a very special attitude to the examination and very specific requirements may appear. Enabling examination without sedation, in the presence of mum or dad, in an open, silent system is the optimal solution for every clinician and every parent.

## Geriatric patients in an open MR system

The "silver tsunami" will soon mean that a significant proportion of the patients in magnetic resonance imaging will be elderly patients, requiring special treatment. An open system enables them to have comfort that a traditional tunnel system will not provide. The patient's wide table (from 70 to 82 cm depending on the model) allows extra comfort and freedom in positioning the patient, and also lying on the side in case of severe backpain. Thanks to the open architecture of the system, the table can move to the sides, allowing the examination of the wrist or elbow joint with a comfortable position at the patient's side, avoiding a painful position with the hand above the head. Open systems architecture means the possibility of eye contact during the examination. In the case of permanent magnet systems (Aperto Lucent 0.4T, AIRIS Vento 0.3T), silent gradients lower the decibel level to the level of ambient acoustic noise, allowing a conversation with a family member or staff in the resonance room during the examination. The Oasis 1.2T superconductive system



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features SoftSound technology for the same function. SynergyDrive together with IP RAPID technology including Compressed Sensing and iterative reconstruction allows the operator to accelerate the entire examination process from acquisition, through automation of all processes and shortening the sequence time, thus reducing the patient's stay in the system to the necessary minimum.



Fig. 3. Eye contact with the patient during the examination

Fujifilm's open systems offer the full range of technologies and sequences needed for the diagnosis of geriatric patients – for both basic and advanced applications. In neurological tests, depending on the model of the MR system, the following are available: diffusion with automatic calculation of the ADC map in the study of stroke, TOF and PC angiography, angiographic examinations of the carotid arteries with and without the administration of contrast media (CE Angio and **VASC-ASL**), isotropic brain sequences 3D isoFSE and isoRSSG in the diagnosis of dementia, brain spectroscopy or micro bleeding examination (Blood Sensitive Imaging **BSI**). Unique technologies offered only by Fujifilm – **BeamSat TOF** (non-invasive selective



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angiography of cerebral arteries) and **SIR Map** (analysis of carotid atherosclerotic plaques without contrast agent administration) complete the offer of neurological research. Studies of **the musculoskeletal** system are supported by unique, dedicated coils based on solenoid technology, the use of which is possible due to the vertical direction of the magnetic field. This technology provides a homogeneous signal throughout entire FOV field, without losing the signal depending on the distance from the coil, which occurs with surface coils. In the Oasis 1.2T high-field system, the unique butterfly coil technology combines the advantages of solenoid coils with RAPID parallel imaging, enabling fast imaging with excellent signal uniformity. Various fat separation techniques are available— from traditional STIR, through spectral saturation CHESS and Dixon **FatSep** separation, available for 2D and 3D sequences, both FSE and GE and SE. The color map of T2 allows assessing early changes in cartilage in the knee. Most geriatric patients will sooner or later have a metal knee or hip implant. The presence of metal implants is not a contraindication for imaging in a low-field system and the primeFSE sequence allows imaging of the implant area to assess the course of postoperative treatment and possible reoperations.

Fujifilm open MR systems provide an optimal solution for geriatric patients, while being patient-friendly and fully fulfilling the diagnostic needs of the radiologist and clinician.

## Study of patients with obesity in the open MR system

Fujifilm offers open systems with a wide, comfortable patient table with a maximum load of up to **300 kg** (Oasis 1.2T). The unique technology of the receiving coils makes it possible to achieve a homogeneous signal throughout the entire scanned FOV, which allows a high quality of examination. In the case of patients with giant obesity, not fitting into the receiving coil, it is possible to perform the study using a coil built into the T/R gantry (transmit/receiver)





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Fig. 4 Study of an obese patient without a receiving coil

Dedicated L and XL flex coils have been designed especially for patients with larger dimensions. Being a leader on the market of open MR systems, we have been developing both hardware and software for years to ensure excellent quality of the study even in cases as demanding as the study of patients with obesity. There are no restrictions on the use of technologies offered by Fujifilm – silent SoftSound sequences, a full range of angiographic studies with and without a contrast agent injection, and various methods of fat signal suppression (FatSepSE, FatSepGE, FatSepFSE, CHESSE, STIR, Water Excitation). The presence of metal implants is also an everyday reality in the case of obese patients – our primeFSE and FatSep allow for imaging of anatomy with implants.

## Study of patients with claustrophobia in an open MR system

For a patient with claustrophobia, an open-system examination is the only alternative to go through an MRI procedure without pharmacological sedation. Of course, many factors are needed for a successful study. Fujifilm, as a company offering a system for such "special" patients, has to offer above all an open architecture, where the patient



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can always have eye contact with the accompanying person. Oasis, thanks to its asymmetrical columns, allows such contact without even a moment or a centimeter in confinement. Comfortable patient table, silent sequences, RADAR eliminating movement artifacts and available without restrictions, also in diffusion studies RADAR DWI-FSE, the ability to talk during the examination and all using high-end technology to ensure excellent test quality. Vertical magnetic field and special design of the receiving coils allow you to examine the head in a position on the side, without losing eye contact



Fig. 5 Examination of the head in a solenoid coil in a position on the side

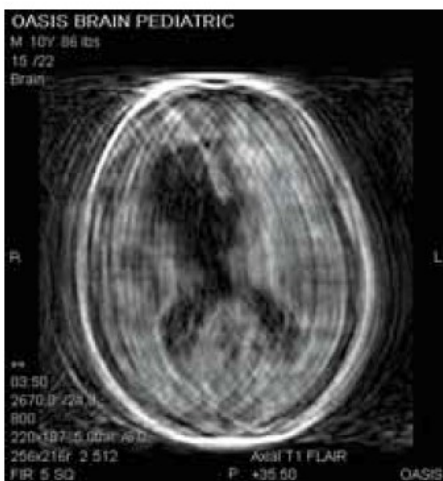
Only an open system allows for such freedom and support for people with claustrophobia. Fujifilm works with a number of facilities specializing in the screening of patients with claustrophobia and assists them in the design of patient-friendly interiors, with an atmosphere that reduces the level of stress associated with the MR examination. These centers train their staff in the specifics of the contact with a claustrophobic patient, from the moment of telephone enrollment for the examination to the successful MR procedure. How a holistic approach can change the success statistics of the study of patients with claustrophobia can be found in testimonials of the facilities offering our open MR systems services.



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### Paediatric patients in an open MRI system

This group of patients accumulates all the challenges of examination in the MR system listed in the previous paragraphs. The examination should be fast, quiet, and in the presence of a parent, without sedation. The system should be friendly, the atmosphere at the site should be nice, the patient's bed comfortable and wide, so that sometimes the parent can fit as well. All without compromising on the quality of the examination and the diagnostic capabilities of the system. Fujifilm offers open systems with silent sequences; a whole range of non-invasive angiographic examinations without the use of a contrast media, **RADAR** technology for each coil, sequence and anatomy, responds to the needs of this special group, where not only the patient but also their family have special requirements.



Pediatric patient without RADAR



Pediatric patient with RADAR

Fig. 6 Examination of the child's head without and with RADAR

Fujifilm is a market leader in open magnetic resonance imaging systems and as such specializes in solutions for special patient groups. Elderly people, obese, with claustrophobia, children – these are groups that will increasingly require magnetic resonance imaging. And the specificity of these groups requires special solutions – our open, patient-friendly Oasis, Lucent and Vento systems offer such solutions. We invite you – we are open!

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