

## Prevalence of Inguinal Hernia in Relation to Various Risk Factors

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### Abstract

**Background:** Inguinal hernia is part of the small intestine bulge through a weak area in the lower abdominal wall which occurs at the inguinal canal in the groin region. inguinal hernia is either direct which usually occur only in male adults and are caused by a weakness in the muscles of the abdominal wall that develops over time or indirect which are caused by a defect in the abdominal wall that is congenital, or present at birth.

**Objective of the Study:** This article is intended to provide an overview of the prevalence and incidence of Inguinal Hernia in relation to relevant predisposing factors.

**Methods:** Electronic search in the scientific database from 1966 to 2017- (Medline, Embase, the Cochrane Library as well as NHS centre websites were searched for English Publications were obtained from both reprint requests and by searching the database. Data extracted included authors, country, year of publication, age and sex of patients, epidemiology, geographical distribution, pathophysiology, risk factors, clinical manifestations, investigations and types of surgical treatment.

**Results:** The pathophysiology explains the higher prevalence of inguinal hernias and predominance in males over females in the middle age group in the incidence of primary and recurrent inguinal hernia. In addition to that, Right side occurrence was more common and the main risk factors are basically straining or lifting heavy objects and irregular bowel movements.

**Keywords:** Inguinal Hernia; Epidemiology; Risk Factors; Prevalence; Epidemiology

**Introduction**

Hernia is defined as a protrusion of an organ through an abdominal opening in the muscle wall of the cavity that surrounds it [1]. It may be congenital or may result from the failure of certain structures to close after birth or may acquire later in life because of obesity, muscular weakness, surgery or illness [2]. The common sites of herniation are the groin, umbilicus, linea alba, semilunar line of spiegel, diaphragm and surgical incisions [3]. The inguinal canal is a passage through the lower abdominal wall. People have two inguinal canals-one on each side of the lower abdomen. In males, the spermatic cords pass through the inguinal canals and connect to the testicles in the scrotum-the sac around the testicles. The spermatic cords contain blood vessels, nerves, and a duct, called the spermatic duct, that carries sperm from the testicles to the penis. In females, the round ligaments, which support the uterus, pass through the inguinal canals [4].

**Methods**

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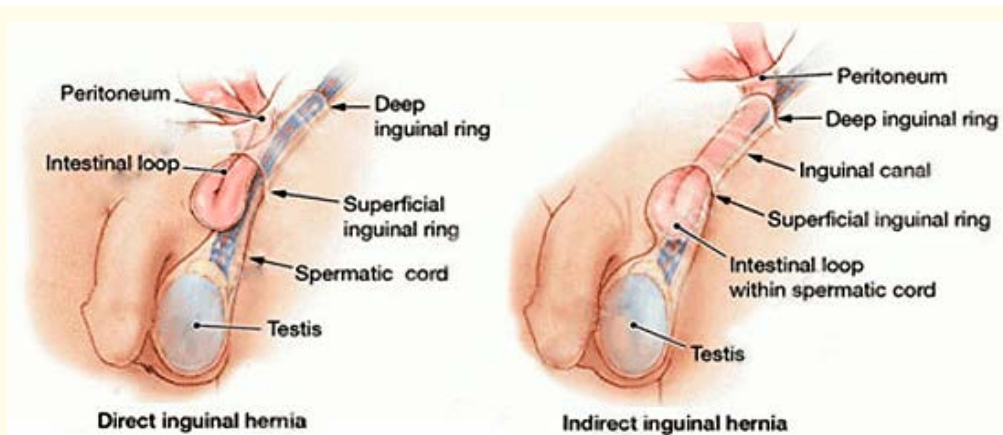
**Classification**

The classification of inguinal hernia has been considered as a useful tool for the surgeon to decide which type of hernia repair may be the best in the individual patient. Several important contributions were made by American, French and German surgeons. Classifications, therefore, are not regarded as eternally firm constructions, but reflect the developments in hernia surgery.

**Anatomical [5]**

Inguinal hernias, are classified according to the relationship of the hernia sac to the inferior epigastric artery as useful

1. Direct - hernia sac comes through the inguinal floor medial to the inferior epigastric artery and the deep inguinal ring; when abdominal contents herniate through a weak spot in the fascia of the posterior wall of the inguinal canal, which is formed by the transversalis fascia (Figure 1) [6].
2. Indirect - hernia sac comes through the internal (deep) inguinal ring, lateral to the artery. An important subclassification of indirect hernia is sliding hernia, in which bowel fused to the peritoneum comes through the internal inguinal ring (Figure 1) [6].
3. Combined hernias (direct +indirect).
4. Pantaloon or Romberg or saddle bag hernias.



**Figure 1:** Illustrative drawing for Direct versus Indirect Inguinal Hernia.

**Inguinal hernia may be further sub-classified into the following groups:**

- Reducible - the contents of the hernia may be reduced completely.
- Irreducible or incarcerated - the contents may not be reduced. If bowel is incarcerated, it cannot be reduced into the peritoneal cavity, but its blood supply has not been compromised.
- Strangulated - an incarcerated hernia in which the blood supply of the hernia contents is compromised, causing ischaemia. Unless relieved, gangrene and perforation of the affected bowel segment ensues. A strangulated hernia can also contain omentum or other viscera, such as bladder.

**Nyhus classification [7]**

- Type 1 - indirect inguinal hernia with normal internal ring (congenital, as seen in infants and children).
- Type 2 - indirect hernia with dilated internal ring but normal posterior inguinal wall (usually seen in children and young adults).
- Type 3 - posterior wall (inguinal floor) defects:
  - 3A: Direct hernia.
  - 3B: Indirect hernia with dilated internal ring associated with or caused by weakness of posterior wall; includes sliding hernia. Type 3B hernias are acquired, not congenital.
  - 3C: Femoral hernia.
- Type 4 - Recurrent inguinal hernia.

**Clinical Manifestations**

Inguinal hernias present with a lump in the groin that goes away with minimal pressure or when the patient is lying down. Most cause mild to moderate discomfort that increases with activity. A third of patients scheduled for surgery have no pain, and severe pain is uncommon (1.5% at rest and 10.2% on movement) [8].

Inguinal hernias are at risk of irreducibility or incarceration, which may result in strangulation and obstruction; however, unlike with femoral hernias, strangulation is rare. National statistics from England identified that 5% of repairs of primary inguinal hernia were emergency operations in 1998-9. Older age and longer duration of hernia and of irreducibility are risk factors for acute complications. Gallegos and colleagues studied the presentation of inguinal hernias with a “working diagnosis of strangulation.” Only 14 of their 22 patients with an acute hernia had compromised tissue at operation, with one of 439 patients requiring bowel resection [9]. Though the study numbers are small, these findings emphasise the rarity of strangulation. A recent larger study estimated the lifetime risk of strangulation at 0.27% for an 18-year-old man and 0.03% for a 72 year old man [10].

**Etiology and Epidemiology of Inguinal Hernia**

An indirect inguinal hernia is considered mainly to be a congenital lesion. It is denoted “indirect” because the bowel and peritoneum do not herniate directly through a weakness in the abdominal wall. Rather, the bowel and peritoneum move through a patent processus vaginalis (hence it being a congenital defect) and into the scrotum. This also lends to the analogy that “in”-direct hernias extend “in” through the internal ring. As such, they technically protrude lateral to the inferior epigastric vessels [11].

The hernia itself consists of a sac of peritoneum extending through the internal ring, antero-medial to the spermatic cord in males (or round ligament in females), through which omentum or bowel can traverse.

The larger the defect and extension into the scrotum, the higher the risk of incarceration and/or strangulation [11].

Males are much more likely to develop inguinal hernias than females. About 25 percent of males and about 2 percent of females will develop an inguinal hernia in their lifetimes [12]. Some people who have an inguinal hernia on one side will have or will develop a hernia on the other side.

People of any age can develop inguinal hernias. Indirect hernias can appear before age 1 and often appear before age 30; however, they may appear later in life yet Premature infants have a higher chance of developing an indirect inguinal hernia. Direct hernias, which usually only occur in male adults, are much more common in men older than age 40 because the muscles of the abdominal wall weaken with age [13].

People with a family history of inguinal hernias are more likely to develop inguinal hernias. Studies also suggest that people who smoke have an increased risk of inguinal hernias [14].

### Prevalence of Inguinal Hernia

Abdominal wall hernias are common, with a prevalence of 1.7% for all ages and 4% of those who are over 45 years of age. The inguinal hernias account for 75% of the abdominal hernias with a life time risk of 27% in males and 3% in the females [15].

Repair of inguinal hernia is one of the most common operations in general surgery, with rates ranging from 10 per 100,000 of the population in the United Kingdom to 28 per 100 000 in the United States [16]. In 2001-2 about 70,000 inguinal hernia repairs (62 969 primary, 4939 recurrent) were done in England, requiring more than 100,000 hospital bed days. Ninety-five per cent of patients presenting to primary care are male, and in men the incidence rises from 11 per 10,000 person years aged 16 - 24 years to 200 per 10,000 person years aged 75 years or above [17].

A study conducted in western Jerusalem [18] concluded that after adjustment for age, the prevalence of hernia was significantly related to six variables (Table 1 and Table 2). The rate was relatively high in the presence of varicose veins, prostatic hypertrophy, and haemorrhoids; it was relatively low in the presence of overweight or adiposity as measured by relative weight, Quetelet's index, or the suprailiac skinfold thickness. Other skinfold measurements (triceps and subscapular) showed similar trends, but they were not statistically significant [18].

Variable	Varicose veins		Probable prostatic hypertrophy		Reported haemorrhoids	
	Absent	Present	Absent	Present	Absent	Present
No. of men	1628	245	1712	194	1360	516
Age-standardised lifetime prevalence rate (%)	22.7	34	23.6	32.1	22.9	27.6
Relative risk	1.7		1.6		1.3	
P Value	0.0006		0.01		0.046	

**Table 1:** Relationships between prevalence of inguinal hernia and Varicose veins, Probable prostatic hypertrophy and Reported haemorrhoids; adjusted for age\*.

Variable	Relative weight				Quetelet's index				Suprailiac skinfold (mm)				
	< 100%	100- 109%	110-119%	120%+	<0.23	0.23-0.25	0.260-27	0.28+	<10	10-14	15-19	20-29	30+
No. of men	481	868	447	389	447	660	361	376	272	394	435	538	199
Age-standardised lifetime prevalence rate (%)	27.7	25.4	25.9	19.8	25.4	24	27	19	30.2	26.1	22.2	22	22.5
Relative risk	0.7				0.7				0.7				
P Value	0.006				0.01				0.008				

**Table 2:** Relationships between prevalence of inguinal hernia and Relative weight Quetelet's index and Suprailiac skinfold (mm) adjusted for age\*.

\*The rates and statistical indices are adjusted for age. The estimated relative risk associated with the specified condition, with a relative weight of 120%+, with a Quetelet's index of 0-28+, or with a supramiac skinfold of 15 mm or more. Significance of the difference of the relative risk from unity.

Another study conducted in Tanzania conducted that the prevalence of inguinal hernia in Tanzanian adults is 5.36%, and an estimated 12.09% of men had hernias [19]. It has been argued that, since surgery is the main elective treatment for repairing inguinal hernia, surgical audit data can be considered a reasonable indicator of incidence/prevalence rates. In England for instance, about 70,000 inguinal hernia repairs are performed each year, and this constitutes approximately 0.14% of the population each year [20]. These statistics give an insight into the burden of this disease.

### Risk Factors

Many health-care providers may consider inguinal hernia to be largely limited to male infants with an anatomical defect in the inguinal canal [21].

An unexpected finding was the lower incidence of inguinal hernia among overweight and obese men as compared with normal-weight men [22]. The risk among overweight men was 80 percent of that of normal-weight men, and the risk among obese men was only 50 percent of that of normal-weight men. It is possible that our findings resulted from ascertainment bias due to greater difficulty in diagnosing hernia among heavier persons. On the other hand, overweight and obese persons have more comorbidity requiring medical care and have a greater opportunity for a hernia diagnosis, which actually could have led to underestimation of the strength of a protective effect in our analysis. Among men with at least one facility stay, the lower risks of hernia among the overweight and obese were unchanged, while the strength of association of age, race, and hiatal hernia were diminished. Thus, receipt of medical care does not explain the lower risk of inguinal hernia among the overweight and obese [22].

A lower risk of inguinal hernia with overweight and obesity was also suggested in a community survey of men in Israel [18] and in a hospital-based case-control study of women in the Netherlands [23]. A plausible explanation for a protective effect of greater adiposity exists in that among heavier men, abdominal wall musculature may be strengthened by carrying excess fat, providing a stronger barrier against herniation. If this is true, one might expect a central fat distribution, in particular, to be protective. However, we did not have information available on waist circumference or other measures of abdominal fat. More research is needed to determine whether the association of inguinal hernia with overweight and obesity is real. The effect of body fat distribution needs to be investigated as well.

The incidence of inguinal hernia was much higher in men than in women, as has been previously shown [24]. Factors that were independently associated with a higher incidence of inguinal hernia among women were middle or older age, rural residence, height in the upper two thirds, chronic cough, and umbilical hernia.

Among men, we found an incidence of inguinal hernia among Blacks that was less than 60 percent of that of Whites. This lower rate of hernia among Black men could have resulted from a lower rate of utilization of medical care, with less opportunity for a hernia diagnosis. Among men with at least one facility stay, Blacks had a lower risk of hernia, although this result no longer reached statistical significance. Racial differences in body mass index could also have contributed, but the lower incidence in Blacks remained in multivariate-adjusted analysis.

The final factor that we found to be associated with a greater incidence of inguinal hernia was doctor-diagnosed hiatal hernia, which almost doubled the risk. Some men who reported a doctor-diagnosed hiatal hernia at baseline may have confused it with a history of inguinal hernia. However, an association between the two types of hernias was also seen in an Italian case-control study of endoscopy-diagnosed hiatal hernia [25]. In that report, the risk of inguinal hernia upon physical examination was increased 2.5-fold among persons with hiatal hernia, though the older age of the hiatal hernia patients may have confounded the relation. An association between these two forms of hernia could be due to a common mechanism of increased intraabdominal pressure.

Increased intraabdominal pressure has long been suspected in the pathogenesis of inguinal hernia, though with little quantitative evidence. We investigated but did not find an association with additional factors that might exert an effect through such a mechanism, including physical activity, constipation, chronic cough, and chronic obstructive pulmonary disease. Our physical activity measure was limited

to two interview questions, each with three possible subjective responses. An increased risk of inguinal hernia with greater physical exertion was found in two Spanish hospital-based case-control studies investigating occupational activity [26] or both work and recreational activity [27], while greater current sports activity was found to decrease the risk among Dutch women [23]. There was no relation with work-related physical activity among Israeli men. Other factors that might increase intraabdominal pressure were not associated with inguinal hernia in previous studies, with the exception of an increased risk with obstipation in the Dutch study [23,27].

Structural weakness of the supporting tissue is another potential mechanism in the pathogenesis of inguinal hernia. A defect in collagen synthesis by fibroblasts has been suggested as a cause of inguinal hernia [28]. Smoking, which may adversely affect connective tissue metabolism, has been proposed as a risk factor for inguinal hernia [29] and was associated with hernia recurrence among smokers in one study. We did not find an increased incidence of inguinal hernia among current or former smokers. However, smoking may have a greater adverse effect on connective tissue healing than on intact connective tissue. Smoking was also unrelated to a first hernia diagnosis in previous reports [23,27]. Likewise, no relation of inguinal hernia with alcohol intake was seen in our study or in a previous one [27].

### Pathophysiology

Indirect inguinal hernias usually occur because of a persistent processus vaginalis. This leaves an empty peritoneal sac lying in the inguinal canal. The hernia becomes clinically evident when bowel or other abdominal content fills and enlarges the empty sac, creating a visible bulge. The hernia sac follows the spermatic cord down into the scrotal sac in men, or follows the round ligament in women to the pubic tubercle. Indirect hernias may be congenital (closely adherent to the vas deferens) or acquired (anatomically separate from the vas). Most hernias in women are indirect.

Direct hernias are always acquired and therefore unusual under the age of 25. A direct inguinal hernia occurs because of degeneration and fatty changes in the aponeurosis of the transversalis fascia that constitutes the inguinal floor or posterior wall in the Hesselbach triangle area. The Hesselbach triangle is defined inferiorly by the inguinal ligament, laterally by the inferior epigastric artery and vein, and medially by the lateral border of rectus abdominus. Most direct hernias do not have a true peritoneal lining and do not contain bowel, but mainly preperitoneal fat, and occasionally bladder. A large, long-standing direct hernia can extend into the scrotum and can harbour bowel or abdominal content.

Because the structural defect in a direct hernia is most often a diffuse weakness and stretching of the inguinal floor tissues, rather than a discrete, sharply defined ring-like defect, it rarely strangulates. Strangulation is more common with indirect hernia, which has a narrow neck. As segments of the intestine prolapse through the defect in the anterior abdominal wall, they cause sequestration of fluid within the lumen of the herniated bowel. This initially impairs the lymphatic and venous drainage, which further compounds the swelling, and over time the arterial supply also becomes impaired. Gangrene ensues and, if left untreated, perforation occurs. Peritonitis occurs initially within the sac and then spreads to the peritoneal cavity [30].

### Diagnosis

Hernias may be easily diagnosed with an adequate physical examination. The physical examination should begin by carefully inspecting the femoral and inguinal areas for bulges while the patient is standing. Then, the patient should be asked to strain down (i.e., Valsalva maneuver) while the physician observes for bulges [31].

This may be accomplished by using the right hand to examine the patient's right side and the left hand to examine the patient's left side. The physician invaginates the loose skin of the scrotum with the index finger on the ipsilateral side of the patient, starting at a point low enough on the scrotum to reach as far as the internal inguinal ring. Starting on the scrotum, the examining finger follows the spermatic cord upward above the inguinal ligament to the triangular, slit-like opening of the external inguinal ring. The external inguinal ring is medial to and just below the pubic tubercle. The inguinal canal is gently followed laterally in its oblique course. While the examining finger is in the canal next to the internal inguinal ring, the patient strains down or coughs as the physician feels for any palpable herniation [32]. The diagnosis of an inguinal hernia is confirmed if an "impulse" or bulge is felt.



If no bulge is detected with a Valsalva maneuver, a hernia is unlikely. However, athletic pubalgia (sports hernia) may be considered in athletes with groin pain and no bulge. A sports hernia is not a true hernia, but rather a tearing of tissue fibers. This typically occurs in patients with a history of high-intensity athletic activity. Although these patients have typical hernia symptoms, there is no evidence on physical examination. Further follow-up and reexamination are needed to diagnose a sports hernia. Pain along the symphysis pubis suggests osteitis pubis, whereas pain along the adductor tendons suggests adductor tendinopathy.

It is more challenging to diagnose a hernia in female patients. Direct palpation with an open hand over the groin area might detect the impulse of a hernia during a Valsalva maneuver. However, further workup with diagnostic testing or referral to a surgeon is often indicated. Rarely, diagnostic laparoscopy is necessary.

Incarceration may be managed in the office setting if there is no associated pain. The standard of care is to place the patient in the Trendelenburg position while holding gentle pressure on the area for up to 15 minutes. If acute onset of groin pain occurs, the hernia may have become strangulated (i.e., the blood supply to the entrapped contents is compromised). Strangulation should be suspected in the presence of tenderness, redness, nausea, and vomiting and is a surgical emergency [33].

### Diagnosis using Imaging

Despite the fact that imaging is rarely needed to diagnose a hernia, it may be useful in certain clinical situations (e.g., suspected sports hernia; recurrent hernia or possible hydrocele; uncertain diagnosis; surgical complications, especially chronic pain) [34]. The clinical use of ultrasonography has shown promise in these situations [35]. The sensitivity of ultrasonography for the detection of groin hernias is greater than 90%, and the specificity is 82% to 86% [34].

Use of higher resolution axial computed tomography in the diagnosis of inguinal hernia is being investigated [36]. Magnetic resonance imaging may be useful in differentiating inguinal and femoral hernias with a high sensitivity and specificity (greater than 95%) [34]. The use of magnetic resonance imaging is helpful in the diagnosis of athletic pubalgia or sports hernias, which may occur at any age with potentially more than one cause. The physician may consider magnetic resonance imaging in the workup of patients with activity-related groin pain when no inguinal hernia can be identified on physical examination [37].

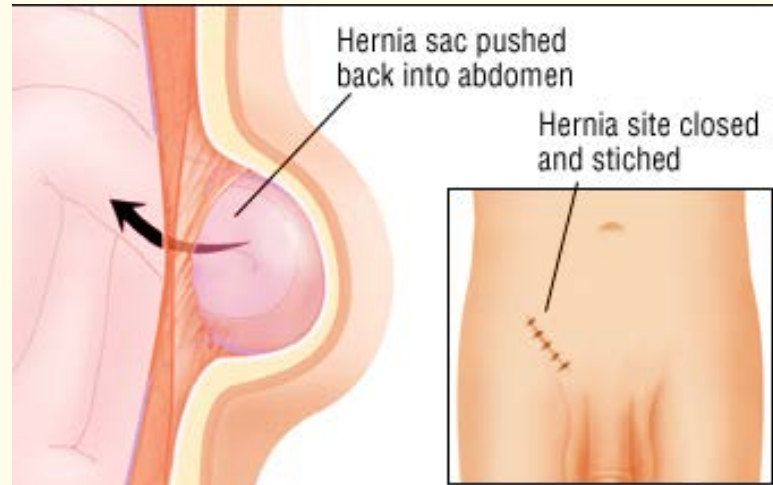
### Inguinal Hernia Management

No medical recommendation for inguinal hernia management since elective surgery have been recommended for all types of inguinal hernias behind the feared risk of complications such as incarceration or strangulation [38]. Nevertheless, in most cases, surgical repairs are not carried out to prevent strangulation, but because of patients' request, to relieve discomfort [39]. A cautious decision is therefore recommended for an optimal solution for the presented case, especially for minimally symptomatic hernias due to the significant risk of chronic post herniorrhaphy pain (> 10%), and the low risk of incarceration (<0.2% per year) [38].

Most inguinal hernia repairs can be performed safely, accurately and cost-effectively using local anesthesia, through an open anterior approach. Hernia recurrence rates of less than 4% have been reported for herniorrhaphies performed without prosthetic mesh by skilled surgeons [40]. Hernia repair using prosthetic mesh would be a good choice in the patient with a direct hernia or in the older patient with a longstanding hernia and attenuated fascia. Recurrent hernias repaired with classical herniorrhaphy not utilizing mesh have a reported recurrence rate of approximately 23% at three years [41]. For this reason, recurrent hernias are best managed with open anterior or posterior mesh repair and laparoscopic repair.

### Surgery management

Hernia repair may be done through open or laparoscopic surgery. Both usually are done on an outpatient basis. Most inguinal hernias are repaired by open surgery. The surgeon makes an incision in your groin, then pushes the herniated tissue back into place. He or she repairs the hernia - the hole in the wall of tissue - by stitching together the edges of the hole. It's no different from stitching together a hole in a shirt. A small piece of synthetic mesh material reinforces the area to prevent another hernia (Figure 2).



**Figure 2:** Illustrates the simplified concept of Surgery management for Inguinal Hernia [42].

## Type of Repairs

### Mesh repair

Meshes have reduced the rate of recurrence of hernias significantly, but some problems related to meshes have been reported [43]. A mesh has certain features like material, strength, elasticity, density, pore size. Standard polypropylene mesh is the most frequently used one. It is cheap, available, non-absorbable, and strong enough to avoid recurrence. Nevertheless, some actual problems with mesh use like foreign body sensation and chronic post-operative pain have created a conflict about standard polypropylene mesh [43]. Polyester mesh might be an alternative, but did not gain popularity as it can degrade with time, especially in infected areas [43].

### Suture repairs

The Bassini technique is a “tension” repair, in which the edges of the defect are sewn back together, i.e. the conjoint tendon is approximated to the inguinal ligament and closed without any mesh. Interest in Bassini’s technique is now historical, but remains performed in some developing countries, if surgeons do not have knowledge of the tension-free repairs. In McVay/Cooper’s ligament repair, the floor of the canal is reinforced by approximating the transversus abdominis aponeurosis and transversalis fascia to pectineal (Cooper’s) ligament medially from the pubic tubercle to the femoral vein. Lateral to this, the floor is restored by approximating the femoral sheath to the inguinal ligament. It is also used in femoral hernia repairs. The Desarda technique is an emerging suture-based technique. This technique is tension-free, mesh-free, and pays attention to the surgical physiology of inguinal canal [44]. It uses the external oblique aponeurosis sutured to the inguinal ligament and internal oblique to reinforce the posterior wall of the inguinal canal [44]. It also gives similar results to Lichtenstein in terms of recurrence, with the significant benefit of not introducing permanent foreign-body material [45]. Likewise, the Guarnieri is another tension-free technique which pays attention to the surgical physiology of inguinal canal. In this procedure where a mesh is not used, the inguinal canal is reinforced by overlapping the external oblique aponeurosis in a double breasted fashion. Suture repairs the Shouldice technique is a relatively difficult four-layer reconstruction of fascia transversalis; however, it has relatively low reported recurrence rates in the hands of surgeons experienced with this method.

### Laparoscopic repair

This technique for repair of hernias has varying degrees of usage in different industrialized countries, and one of its disadvantages is that it needs surgeons highly experienced in laparoscopic hernia surgery [43]. Whereas its use is confirmed to be low in some industrialized countries like the United Kingdom and Japan, laparoscopic hernia repair has gained popularity in North America and some European



countries, like Germany, accounting for 15 - 30% of hernia repairs in these countries [43]. Laparoscopic repairs are more expensive than open repairs. Whereas Hynes, *et al.* reported that laparoscopic repair costs an average of \$638 more than open repair in North America, McCormack, *et al.* [20] reported that in the UK, laparoscopic repair cost an extra 300 - 350 pounds per patient. The two-main laparoscopic inguinal hernia repairs are the totally extraperitoneal (TEP) and transabdominal preperitoneal patch (TAPP) repairs and each is regarded as tension-free and requires the use of mesh.

## Conclusion

Hernias happen more frequently in certain parts of the body, like the abdomen, groin and upper thigh area, and umbilical area. They also can happen in any place where you may have had an incision from surgery. It might take a long time for a hernia to develop or it might develop suddenly. Hernias are caused by a combination of muscle weakness and strain, although the cause of the weakness and the type of strain may vary.

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